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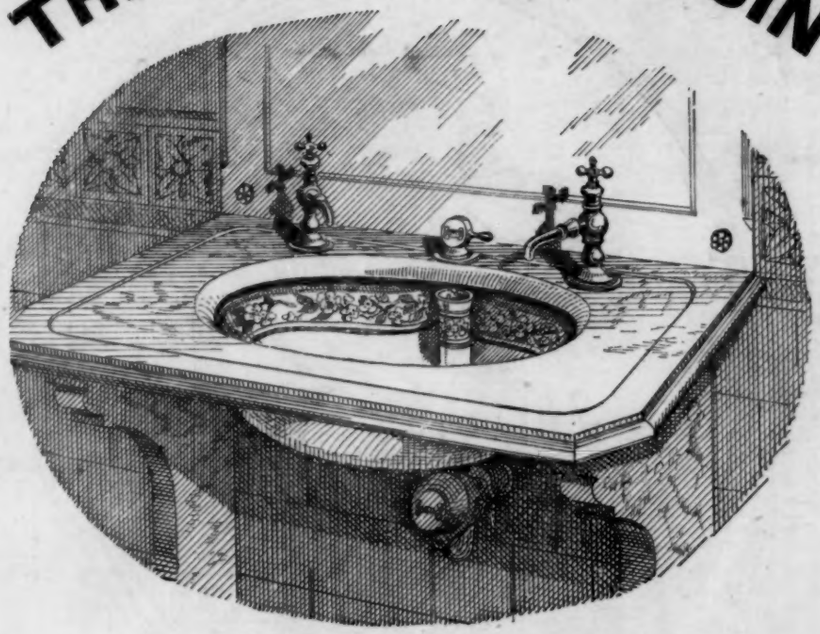

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CONTRACTORS will be interested in a difficulty which the builder of the new Hall of Records in Jersey City has got into. The new building adjoins the Court-house, and since the commencement of the September term, the judges and other court officers have been much annoyed by the noise proceeding from the operations next door. A few days ago, after it had become necessary to suspend the trial of cases on account of the racket, the judge summoned the contractor and his men before him, and told them that the noise must be stopped while the court was in session. The men were then allowed to depart, but as soon as they got back to their places they began to work with as little regard for judicial nerves as ever. The judge sent for them again, and threatened them with punishment for contempt of court unless they obeyed his orders; and on the appearance of some signs of resistance on the part of the contractor, he had constables detailed by the sheriff to see that the objectionable operations were stopped. Naturally enough, the contractor regards this interference with his work on the part of the county officers as a violation of the contract, and proposes, if he is prevented from carrying it out in the usual way, to sue the county for damages. If his contract were with a private owner, we should say that he had a strong case, as one party to a contract certainly could not prevent the other from carrying out his argument without forfeiting the advantage of it, and becoming liable for damages to the other party; but the application of the law to the officers of the law is a somewhat delicate process, and it will be interesting to learn the result of the controversy.

A SINGULAR piece of work has just come to grief in Philadelphia. It seems that eleven years ago a certain real-estate owner decided to build eight houses on Chestnut Street. His lot had been filled in with gravel, brick-bats, ashes and other rubbish, and he wished to get a cheap foundation, which should be sufficient to prevent his houses from sinking into the soft ground. With the consent of the Inspector of Buildings he arranged to build the cellar walls on a footing of hemlock planks, the Inspector, according to the newspaper story, remarking that if the planks should rot, the mortar would have become so hard that it would keep the houses from going to pieces. There was no water in the ground, and the hemlock pieces were simply laid on the rubbish, to a depth of six inches or more, and the houses were then built on the planks, of brick, four stories high. Last July indications began to be observed that the hemlock had rotted, and that, contrary to the Inspector's anticipations, the mortar had failed to hold up the houses without the accustomed aid from below. Dislocations appeared in the cellar walls, the drain-pipes broke off, the door-frames became distorted, and the walls of the superstructure began to crack in all directions, until the front wall of one of the houses had become so cracked that, according to a reporter, it looked as if overrun with ivy. The property had passed into the hands of the Girard Trust Company, and repairs were at once commenced. It was found that the hemlock footings were reduced to a mass of crumbling fragments, and they are being replaced with stone, while the fronts will be entirely rebuilt.

M. DIEULAFOY, the explorer of Susa, has published a book on Persian antiquities, in which he presents some interesting suggestions on the origin of the mediæval system of architecture, and its relations with that which existed in Persia three or four hundred years before. M. Dieulafoy was once an assistant to the late Viollet-le-Duc in his labors in the restoration of mediæval monuments, and was very closely associated with him, so that his opinions upon the sources of the architecture of the Middle Ages are worthy of the highest respect. As we know, Viollet-le-Duc recognized the similarity, in many points of construction and decoration, between the French churches of the twelfth century and the Syrian buildings of the fourth century, and supposed that they were due mainly to the influence of the Oriental ideas and objects which were brought back to Europe by the returning Crusaders, although the way had been to a certain extent prepared for them by the Venetian traders, who maintained a constant traffic between the Atlantic and the Mediterranean coasts of France. M. Dieulafoy, however, finds the mediæval system of vaulting, by means of a skeleton of ribs, filled-in with panels of light stonework, so similar to Persian construction dating from the fourth and fifth, and even from the second century, that he is compelled to find some way of accounting for what cannot be a mere coincidence.

IT is a matter of history that, after the conquest by the Mussulmans of the region on both sides of the Straits of Gibraltar, and perhaps long before that time, the passage of the Straits was so unsafe for merchant vessels, on account of the pirates who infested the place, that the Venetians, prevented from reaching their richest customers, the English, by sea, established a caravan route from Aigues-Mortes, then one of the best harbors on the Mediterranean coast, northwesterly to La Rochelle, on the Atlantic, where they embarked with their goods and carried them to England. On the long route across France, some five hundred miles, they had regular halting-places, and one of these, Limoges, with the neighboring town of Perigueux, became the great distributing point for such of their wares as they might sell in France, and soon filled with Venetian merchants. The Venetians, who traded continually with Constantinople, brought spices, jewelry, embroideries and other Oriental goods with them, and Persian and Eastern bric-à-brac became tolerably common in the houses of the rich and the treasuries of churches. Naturally enough, the stone-carvers in that region, when they wanted an idea for a new ornamental design, would often take a hint from some Oriental work that they happened to see, and the route of the Venetian caravans is marked to this day with tolerable clearness by the palm-leaf patterns and the interlacing curves, adapted from Persian embroidery, and cut in stone on the old churches. There were other routes by which Persian wares entered France. One frequented road was certainly through Switzerland, probably over the Saint-Bernard pass and through the Rhone Valley, and the church of Saint Maurice, between Martigny and Geneva, still possesses a Persian water-pitcher of the seventh century, probably bought of a Venetian or Greek pedler twelve hundred years ago. The traffic between the East and the West, indicated by these remains, was very flourishing long before the first Crusade and it seems more than likely that some description of the Persian vaulted buildings may have reached the ears of the architects of that day. In fact, as they were quite familiar with Roman vaults, the fragments of which still covered the soil of Southern France, the account of vaults differing from the Roman principally in the use of ribs at the groins would be perfectly intelligible to them, and they would recognize as readily as we should the advantage of the skeleton of ribs and the light filling of the panels. In the year 717, on the accession of the iconoclast Emperor, Leo the Isaurian, a great many artists and artisans fled from Constantinople and took refuge in France and Germany. Many were hospitably received by Charlemagne, and these emigrants, familiar with the art and architecture of Asia Minor, which was to a great extent copied from that of Persia, must have done much

to spread the knowledge of it in Europe. Under Charlemagne and his immediate successors the country was too disturbed for building, but M. Dieulafoy thinks that the artists, and particularly the architects, exiled from Byzantium must have found congenial companions and attentive listeners to their instructions among the monks. In some cases the monks probably took written notes of what their new friends told them for future use, without knowing when they might be of service. Nearly three hundred years later, in the midst of Burgundy, where, ten generations before, Charlemagne had settled his colonies of exiled Byzantines, an abbey church was built, which still stands unaltered, and presents so close a resemblance to two Syrian churches of the fourth century that M. Dieulafoy believes that the monk who designed it must have found in the convent library the notes and plans left by some exiled Byzantine architect during the reign of Charlemagne, and used them as the basis of his building. In the main part of the church not only is the system of vaulting completely Asiatic and not Roman, but the details of the columns and capitals are Oriental. Only in the porch, where the architect's courage seems to have failed him, is there any return to the Roman system of construction which had hitherto been regarded as the foundation of all art. A few years later similar experiments were made elsewhere, and the new system of concentrated forces, framework of ribs and light filling between them, which was unknown to the Romans, but had been familiar to the Persians and Asiatics for a thousand years, rapidly spread through France. If the way had not been prepared for it to some extent by the previous intercourse of the people with the Eastern traders, it may be doubted whether it would have made its way so rapidly, and even now it is not always easy to distinguish whether certain mediæval forms are derivations from Oriental patterns or are only accidentally similar.

A CORRESPONDENT makes, in *La Semaine des Constructeurs* an observation which is new to us, and has a very considerable importance for those who are obliged to build in soft soil. The common idea of architects is, as we know, that foundations in soft soil ought to be so arranged that the pressure shall be the same under each square foot of the ground covered by the footings. In Chicago, where the art of building on yielding ground is carried to great perfection, the footings of piers and walls are calculated with precision, so that the load on each portion shall be supported on an area of subsoil proportionate to the load. It seems, however, that buildings planned in this way do not always show the perfect uniformity of settlement expected of them; the smaller piers, although transmitting the same load as the larger ones to each square foot of earth under them, sinking considerably less, so that in a building, for example, with two side walls, and a row of columns through the middle, the side walls settle more than the foundations of the columns, leaving all the floors higher in the middle than at the sides. In 1864, some experiments were made in France to determine the cause of this phenomenon, and it was found that, besides the resistance of the soil directly compressed under the footings, a good deal of sustaining power was derived from the friction of the surrounding soil. Of course, the amount of friction is proportionate to the perimeter of the footings, and this is greater, as compared with their area, in small piers than in large masses of masonry. Thus a footing-stone five feet square, under a given pier, will have only half the area of a foundation five feet by ten, under a pier of twice the size, loaded with double the weight; but the perimeter of the first footing is two-thirds as large as that of the second, leaving a surplus of frictional resistance in favor of the first, which may hold it up, while the neighboring pier, loaded with twice the weight, and sustained by twice the area of subsoil, is sinking. Just what is the ratio of the sustaining force exerted by friction to that due to the direct reaction of the soil, we are not informed, but in important structures it would be of interest to know; and we hope that some one may pursue the investigation further. The whole subject of friction in soils, as affecting their resistance to a vertical pressure, is a very important one. We all know that a footing of a given area exerts a greater sustaining power, the deeper it is set below the surface, although the compressibility of the soil may be the same at all depths. The reason of this is that a structure is more apt to settle by the lateral escape of earth from beneath its foundations than from the direct compression of the soil, and anything that prevents this lateral escape of earth assists its resistance. In very loose or sandy ground, the lateral escape is prevented by sheet-piling, but in most cases the only check to such a movement is the friction due to the weight of the column of earth pressing upon that just bordering the footings, and tending to keep it in place; and the deeper the footings are set, the heavier will be this column, the greater the resistance to any lateral escape and, consequently, the greater the stability of the foundation.

THE *British Architect* quotes from the *Estate Clerk-of-Works* a discussion on the relative advantages of different sorts of roof-covering for farm-buildings. Most of the participants in the discussion approve of good tiles, as being handsome and durable, and giving, when well laid, a very perfect roof. One person, however, prefers slate to tile, for the reason that tiles retain moisture, and rot the woodwork under them, while the timbers under slate roofs are almost always found dry and perfect. Another speaks of oak shingles as forming a good roof material, which when well nailed with zinc or copper nails will last for centuries; while a third recommends roofs thatched with reeds, which remain good for fifty years or more, and form a covering which is warm in winter and cool in summer, and is thus well adapted for stables and cattle-sheds. Another roof which is mentioned is, we imagine, new in this country, and consists simply of tarred felt, whitewashed outside. The whitewash is made with lime and skim-milk, and is renewed every spring. During the summer it reflects the sunlight, keeping the rooms under it cool, and in winter it helps to preserve the felt from the weather, besides, no doubt, checking in some degree the radiation of the interior warmth. So far as we know, shingle roofs are the only sort which are ever whitewashed here. These are occasionally treated with lime-wash and alum to preserve them, but the effect of the whitewash in repelling the heat of the sun is little thought of, although in our hot summers the practice of painting roofs white, as is done in China, and in Southern France, would certainly be advantageous.

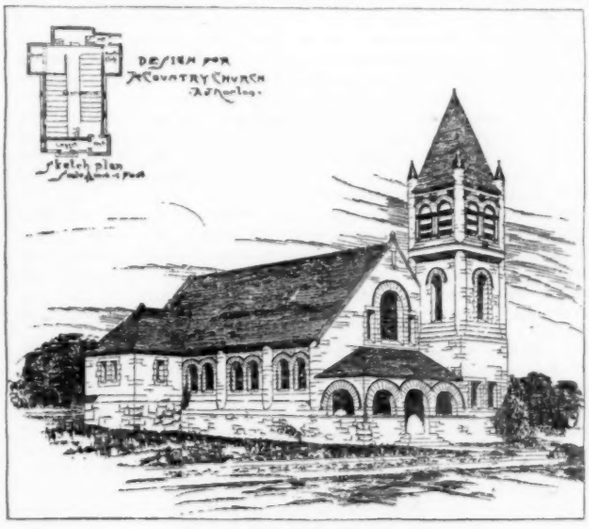
WE hope that the next step in profit-sharing enterprises in this country will be taken in connection with the building trades. In France, the coöperative building-societies have quickly grown to a position of great responsibility, and the United States, with its enormous demand for small dwelling-houses, offers a particularly favorable field for similar associations. For work of the cheaper sort, two carpenters, a mason, a painter and a general helper could associate themselves and carry out houses complete, contracting only for materials, and arranging their work so that each might be constantly employed. It is true that the mason, in a small company, would have to be a bricklayer and plasterer also, but this combination of attributes, although it is looked upon with horror by the trades' unions, is often found among country workmen, and it is among men trained in the multifarious duties of country practice that such companies must be recruited. Once organized, it seems to us that an unlimited business would await them. The advantage to owners of finding the necessary men always at command to carry their buildings along to completion without interruption, instead of subjecting them to the interminable delays, carelessness and indifference of sub-contractors, would be so enormous that the work of a band of coöperating mechanics might well command a premium, while the economy of time and labor secured by men acting together, understanding each other's ways and wishes, and knowing exactly when their work will be ready for them, must be very considerable. We imagine that most architects would say that one-third, at least, of the time for which workmen in the building trades are paid is consumed in waiting for some one else to do something. From the time the cellar is dug until the house is occupied there are always persons in or about it waiting for "the boss to come," or "some one to set them at work," or "the stock to get there," or the "tools to arrive," or "the carpenter to cut a hole in the floor," or "the mason to furnish a chip to level up with," or a thousand other things, while the whole affair will often be at a standstill for weeks together, waiting for some irresponsible sub-contractor to fulfil his promises. A carefully-organized though small association would save the whole of the time spent in these useless delays, and would put in the pockets of its members the money represented by that time. It would be regarded with very little favor by the leaders of the Unions, who desire anything rather than to see men independent and self-reliant, but, if successful, it would open a prospect of employment and comfort to thousands who now look for either in vain.

ARCHITECTURAL EDUCATION IN THE UNITED STATES.[1] — III.

CORNELL UNIVERSITY.

CORNELL University is one of the State Universities founded under the Act of Congress which endowed the several States with thirty thousand acres of land for each senator and representative, and enabled a few struggling colleges to rise at once to the rank of universities. The University of Illinois, the Institute of Technology, Boston, and Cornell University were all founded under essentially the same conditions. Cornell was incorporated in 1865, and opened in 1868. The architectural department was created in 1871 through the efforts of President White, who collected the greater portion of the library, and was personally much interested in the subject of architecture. The department was placed in charge of Professor Charles Babcock, who had received his earlier architectural training in the office of Mr. Richard Upjohn, of New York, and also had had considerable experience in teaching, aside from pure architecture. Professor Babcock had begun his studies with Mr. Upjohn in 1847, and was for five years a partner with his master. After having virtually abandoned the profession for a number of years, he was drawn to it again through the opening of an architectural course in Cornell University. The department started with seventeen pupils. At first, Professor Babcock was obliged to do all the work himself, as the school was but scantily endowed with money and equipments, but in 1880 some outside aid came to hand and the College of Architecture was placed on a more secure footing, more liberally endowed with books, photographs, etc., and Mr. C. Francis Osborne was appointed Assistant Professor. The department has also at present two assistants to aid Professors Babcock and Osborne in the purely architectural studies of the course. The greater share of the work having to do more especially with applied construction and designing is under the immediate direction of Professor Osborne, who has developed many of the methods in use for awakening interest on the part of the student and inciting to continuance in studies; while the theory of architecture, æsthetics, etc., as well as the general management of the whole is supervised by Professor Babcock.

Students in architecture are required to follow a course extending through four years. For the benefit of those who were unable to take, or did not feel the need of, so extended a course of study, there



A Student's Design.

was formerly a special course, but at the close of the past school year, it was decided to admit no more special students in architecture, and the course has, therefore, been discontinued. This change was made from a conviction that the advantages of a school-training for architects have become generally appreciated, and that the time is quite ripe for the University to take the position that its graduates must be thoroughly equipped, so far as preliminary training is concerned, to rise to the highest positions in the profession.

The regular course in architecture, leading to the degree of Bachelor of Science, is as follows:[2]

[1] Continued from No. 662, page 97.

[2] Since writing the above Professor Babcock has made some slight changes in the curriculum, which do not, however, materially alter the general conditions of the course.

FRESHMAN YEAR.

FALL TERM.		WINTER TERM.	
French or German	5[3]	French or German	5
Algebra	5	Trigonometry	5
Rhetoric	2	Rhetoric	2
Free-hand Drawing	3	Free-hand Drawing	3
Drill	2	Linear Drawing and Projection	2
Hygiene, six Lectures		Physical Training	2

SPRING TERM.

French or Grammar	5
Analytical Geometry	5
Botany	3
Free-hand Drawing	3
Drill	2

SOPHOMORE YEAR.

FALL TERM.		WINTER TERM.	
Calculus	5	Building Materials and Construction	6
Descriptive Geometry	3	Electricity and Magnetism	3
Mechanics and Heat	3	Chemistry	3
Chemistry	3	Descriptive Geometry	3
Drawing	1	Physical Training	2
Drill	2		

SPRING TERM.

Construction	6
Acoustics and Optics	3
Blowpipe Analysis and Determinative Mineralogy	2
Shades, Shadows, and Perspective	3
Descriptive Geometry	3
Drill	2
Geology	3

JUNIOR YEAR.

FALL TERM.		WINTER TERM.	
Mechanics, Strength of Materials	5	Mechanics, Trusses	5
Egyptian, Greek, and Roman Architecture	3	Byzantine and Romanesque Architecture	5
Designing	6	Designing	7
Water-color Drawing	3		

SPRING TERM.

Mechanics, Arches	3
Decoration	2
Gothic Architecture	5
Designing	6
Photography	2

SENIOR YEAR.

FALL TERM.		WINTER TERM.	
Renaissance Architecture	3	Modern Architecture	3
Stereotomy	3	Stereotomy applied to Stone-cutting	5
Designing	9	Designing	7
Decoration	3	Military Science	2

SPRING TERM.

Acoustics, Ventilation, Warming, Measuring, Contracts and Specifications, Professional Practice, etc.	5
Designing	5
Modelling	2
Thesis	4

A Student's Design.

It will be seen by this statement that in the first year there is only a very slight admixture of anything pertaining directly to architecture in the course. Practically, there is nothing except linear drawing and projection, which occupy six hours a week during the winter term. In the second year drawing is taught with considerable thoroughness, and during the third and fourth years it is combined with designing; so altogether the student gets considerable experience in drawing, besides which there is always abundant opportunity for any one who is willing to work to get a great deal more practice in architectural training. The drawing-rooms are open nearly all the time, and the students are encouraged to spend there all the time they can.

[3] The number after each study indicates the hours per week devoted thereto each lecture counting 1, and 3 hours of drawing, designing, etc., counting 1.

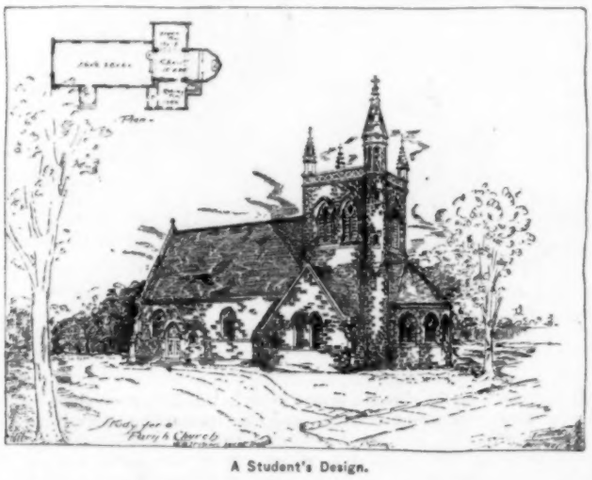
Analyzing the college course with reference to the time given to each study, it will be seen that under the head of pure mathematics, algebra, trigonometry, analytical geometry and calculus together occupy 220 hours. Applied mathematics, such as descriptive geometry, mechanics, etc., occupy 242 hours. The theoretical study of construction occupies 132 hours. Languages, limited to either French or German, 165 hours. The theory of architecture, including history, acoustics, ventilation, etc., 396 hours. Drawing is nominally allowed 2309 hours, and the general college studies, such as hygiene, rhetoric, drill, geology, chemistry, etc., together take up 479 hours, making the total number of hours for the whole course, 3943. It will be seen by this summary that 58.5 per cent of the time is given to drawing, and 770 hours or 19 per cent to studies which are purely architectural in their character, so that altogether 77.5 per cent of the students' time is occupied entirely with architecture, while 22.5 per cent of the entire course is given to studies which do not bear directly upon the profession in one way or another.

There is no instruction in shop-practice. The College does not consider it essential, as it is not thought that an architect will ever be called upon to use it in actual practice, and in any case the time of the students would be too limited to undertake any such study, except by taking time from subjects which are considered much more important.

Construction is taught chiefly by lectures illustrated by a very complete set of models, together with a liberal reference to various text-books.

A great deal of thought has necessarily been devoted to methods of teaching drawing. Most of the students come to the University quite unprepared; indeed, the majority of them are not in any way qualified to begin an architectural course, having had no previous training of any kind in drawing. In the first year nothing is attempted but a little line work and free-hand sketching. In the second term of the second year some general lectures on building-construction are given, to prepare the way for an understanding of what the student will have to draw, rather than to exhaust the subject. In the third term of the same year, the student is taught the rudiments of working-drawings, and is shown how to construct a simple house. A larger house is then worked out by the student, the construction being drawn in detail, and the working-drawings being elaborated to a certain degree. No part of this year's work involves design; the drawings being nearly all copied from models provided by the department, and the attention of the students is confined entirely to construction and to the preparation of working-drawings, specifications and contracts, with a view to the establishment of a thoroughly practical basis for the subsequent work, as also to enable the students to enter during their next summer vacation into practical office-work, which is regarded as a necessary supplement to the course.

During the first term of the Junior year considerable attention is given to analysis of the general principles of house-planning, porches, entrances, halls, etc., with illustrations drawn from actual work of the best architects in the country. About once every week, the ideas which have been suggested during that time are put into practical shape in a design; the problem being laid down pretty carefully in detail and the students required to bring in sketch-plans at one-eighth scale, which are criticised before the class. During the latter part of this term also, there are weekly exercises in sketching plans, forty minutes being allowed for the exercise, to develop the



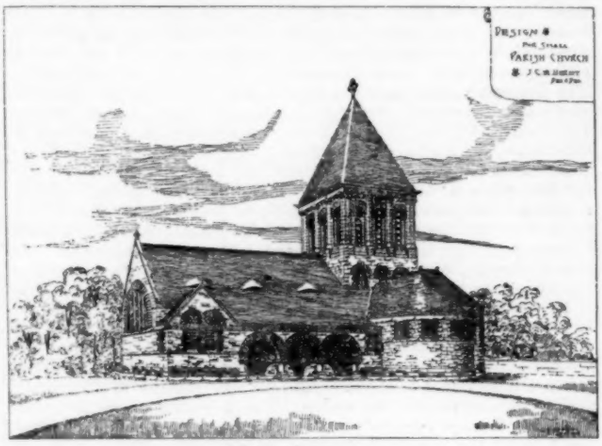
A Student's Design.

student's capacity of getting his ideas into shape in the least possible time.

During the second term of the Junior year, there are lectures on the general theory of design as applied to portions of exteriors, such as arches, walls, courses, roofs, etc. These lectures are given once a week, and special problems are selected to illustrate the individual features. The practice is to gather a number of illustrations from various architectural publications, together with all available photographs, to illustrate the given feature under consideration, and to bring these up in the class, criticising them, pointing out why they are successful or how they fail, teaching the pupil the *raison d'etre* of the various solutions. During this term there is also instruction given in perspective sketching.

During the third term of this year the students are required to work out a complete problem in design, including all plans, elevations and sections of some large building of a public character. These are not put into the shape of working-drawings, but are prepared as eighth-scale studies, together with two finished perspectives of the interior and studies of the interior design.

During the Senior year the work in designing and drawing is planned to give the student a practical acquaintance with the historical styles. The first term is occupied with the study of the round-arched Romanesque, together with sketches for important buildings in that style and the preparation of essays, illustrated by sketches, showing the development of some one feature in its relation to the growth of the style in general, each student being assigned a different feature. In the next term the pointed Romanesque, or



A Student's Design.

Gothic is similarly taken up, while the spring term is given to the study of Renaissance.

Perspective designing is practised once a week, beginning with small subjects, with limited conditions and in a specific style, in order to give the students exercise in sketching and to strengthen them in a knowledge of historic styles. During all the course the students are constantly urged to read and to use photographs freely in connection with their work, and, so far as possible, attempts are made to recognize individual talent, distinctions being made in that the classes each year are grouped according to the ability of the individual, and more extensive problems are given to those who show greater ability. In this way a student who manifests a peculiar talent for architecture is enabled to advance just as rapidly as his own ability will permit. Practically, however, this distinction between the students in regard to their ability is not made until the Senior year, as the most of the time up to that year is occupied by drawing as distinct from designing.

As an adjunct to the Department of Architecture of the University is the Department of Industrial Drawing, in which those who choose can obtain excellent practice in drawing from the flat copy and from models. The students in architecture are required to devote two hours a day to free-hand drawing during the first three terms of the Freshman year, and two hours a day during one term of the Junior year.

The history of architecture is taught entirely by lectures prepared and delivered by Professor Babcock. These are illustrated by photographs, slides, drawings and models. The department has an excellent equipment of photographic apparatus, and is supplied with a large stereopticon. The lecture-room is fitted with tightly closing blinds, so that after the main portion of the day's theme has been elaborated, the shutters are drawn, and the best buildings in the world, having connection with the subject in hand, are thrown upon the screen and explained to the pupils. Besides this, Professor Babcock has a number of printed notes on the history of architecture, which the students obtain and use in following the lectures, and the library is made very available and is always open to the students, so that those who choose may extend their reading, under direction.

There seem to be no definite requirements in regard to vacation-work. The students are encouraged, whenever possible, to spend the vacation in some architect's office and to supplement their theoretical training by a degree of practical experience, which cannot be given them in the University, and we believe that many of the students spend the greater portion of their vacation in this kind of occupation.

In addition to the models, etc., previously referred to, the architectural department has a fine library which was presented by President White, embracing over a thousand volumes pertaining to architecture and kindred branches. The architectural collection

also contains over two thousand photographic prints, most of which are of large size, several hundred drawings, and some two hundred models in stone and wood designed to illustrate the construction, forms and peculiarities of the different styles of architecture. These are all freely accessible to the students of architecture.

The rooms are not very large, but are quite sufficient for the use of the department.

The requirements for admission to the College of Architecture include the ordinary English branches, algebra, plane and solid geometry, physics, trigonometry, and a knowledge of the rudiments of French and German. The student must be over sixteen years of age. There are no restrictions as to sex, and we believe there have been three ladies who have pursued the course of architecture at the College, and have graduated with honors. For the special students, the age must be at least twenty-one, and the admission is without examination, by vote of the faculty, on recommendation of the professor in charge of the department. Such students cannot be candidates for a degree, and their admission must be renewed every year. Special students of architecture must have served at least one year as draughtsman in an architect's office, and must be proficient in plane and solid geometry and in algebra, so as to be able to solve cubic equations. They are admitted only at the beginning of the fall term, and are required to take a prescribed and not an optional course, as previously noted.

The number of students in the department at the end of the College year of 1887 was sixty-seven. This included nineteen special students. The students come chiefly from New York State. New York, Pennsylvania and Ohio, together, sent forty-eight pupils. It is interesting to note that during the College year 1886–87, Troy and Rochester each sent three pupils. Buffalo, Utica, Auburn and Lockport, each sent two, while New York City was represented by a single pupil.

The degree of Bachelor of Science in Architecture is conferred after a satisfactory completion of the full course. Each student before taking the degree must submit to the faculty a satisfactory essay upon some artistic subject, and deposit a copy in the library. There are no post-graduate degrees in the department of architecture. The students are required to leave with the University all their rough studies made during the Junior year, and in the Senior year a single example in a class is retained in each term. Final drawings are required in order to graduate. Each pupil must average sixty, on a scale of one hundred, on his examinations and in class-work, in order to graduate.

The expense of the course at Cornell is quite moderate. The fee for tuition is $25 a term. Besides this, a fee of $5 is charged to every person taking the baccalaureate degree. The following is a fair estimate of the yearly expense:

Tuition, $25 per term,	$ 75
Room, board, lights, fuel, laundry, about	300
Text-books, etc., about	25
Total,	$400

The expense of living in Ithaca varies for board, room, fuel, lights, from $3 to $7 per week. By the formation of clubs students may reduce expense from $3 to $2.50 a week for room and board.

Scholarships and fellowships for Cornell University were founded in remembrance of financial aid once given in a time of need by its trustees: Hon. Ezra Cornell, John McGraw, Esq., Hon. Henry W. Sage, Hon. Hiram Sibley and President Andrew D. White. One hundred and fifty thousand dollars have been permanently set aside to provide encouragement and assistance for students of high character and ability of either sex in the prosecution of college-work. The six scholarships of $200 each are awarded by competition, open to all students, held every September. The scholarships continue for four years, provided the students maintain the same high standard with which they enter. Students from the State of New York have the additional advantage of being able to secure State scholarships which are awarded by an Act of Legislature to the most meritorious applicants for admission to the University. The possession of a State scholarship gives a student the privileges of the University without any charge. The number of State scholarships is limited to one for each county. The Fellows are eight in number. Each one of these yields to the successful candidate the sum of $400 for one year, and, in case of remarkable merit, for two years. Fellows are expected to reside at the University, and to engage in work leading to a higher degree in their respective specialties. A Fellow need not necessarily be a graduate of the University. Each year there has been an architectural student who has held a scholarship, but there have as yet been no Fellows appointed from graduates in architecture.

[To be continued.]

PIPES MADE BY ELECTROLYSIS. — Steam pipes of copper are now made by electro-deposition from sulphate of copper solution. The pipe is formed on an iron core in the depositing bath, and the deposited copper is pressed by a moving tool as it is deposited, so as to give a fibrous strength to the crystalline copper. After the pipe is thus formed it is subjected to hot steam, which expands the copper shell, or pipe, clear off the iron core, thus separating the two. These pipes have no joint, and are said to be very strong, tests showing that they break with strains of from twenty-seven to forty-one tons per square inch. — *Exchange.*

AMERICAN WINDMILLS.

HERE and there in New England, upon the brow of some windy hill, there stands a low gray tower, from the top of which four long latticed spars, set in the four sides of a great shaft, stretch out against the sky. It is the wind-mill of our forefathers. The tapering form of the graceful tower, the radiating arms, the quiet color of the old shingled sides, make of this hoary ancient an architectural accessory of charming value in the landscape. The utility of most of them is a story of the past, the inventive genius of busier times having long since replaced their cumbrous machinery and comparatively-expensive construction with lighter and cheaper, as well as more effective wind-motors. The modern appliances have not, it is sadly evident, inherited the beauty of form distinguishing the older types, and the architectural treatment of the "patent" windmill still offers a problem of some interest for the future.

On a hill-top behind the town of Nantucket stands a fine old gray windmill tower, and I well remember the keen pleasure I felt on first catching sight of an arm of it over the house-tops. I hurried off to hunt up the fascinating bit of antiquity, if one may use such a term of anything American, and climbing the hill by a queer little crooked lane through the rear premises of some old houses, I was rewarded, on reaching the top, by a scene of quiet and restful beauty. On a turf of freshest green stood the old mill upon its base of crumbling field-boulders. Beyond a group of old farm-houses rose the modest eminences of the historic Popsquatch Hills, and to the right lay the heathered "plains," stretching away along the surf side from 'Sconset to Great Neck. The sun was nearly set, and in the clear purpling light the soft gray tones of the old shingled tower were wonderfully in harmony with the color of the whole picture. On a piece of broken millstone under the door I read the inscription: A. D. 1746.

The tower is eight-sided and has a roof, with two gables, the roof bulging at the eaves to cover the widest part of the tower in quaintly irregular fashion. The top is movable. Through one of the gables comes the shaft to which the arms are attached, and from the other extends to the ground a long timber, the boom, with a wheel on the ground-end by which the whole top is turned about to bring the sails in proper position to catch the wind. The old mill is a favorite subject for the amateurs who yearly invade the island, and perhaps no windmill in America has been more painted on big and little clam-shells than has this sea-rimed veteran of old Nantucket.

The fabled prowess of windmills seems to have dwindled since that memorable day when the mighty arm of the wind-giant

unhorsed the knight of La Mancha. Tramping about one bright fall day among the hills of Orleans on Cape Cod I found three windmills of very good form, in a landscape which is admirably adapted as a setting for them. The hills are gently rolling and generally bare of trees upon the tops. Down between them lie pleasant little

valleys, with winding roads, a sedgy pond or two, and pretty farm-houses under groups of handsome trees. The golden rod was glorious among the sere fall grasses. The coloring in the fields and the trees was everywhere delightfully warm. As I sketched away in great content at a very interesting conical-roofed tower near the village, a mill on the high hill beyond made sail, and I watched its white wings flashing in the sunshine as the great arms flew round in the freshening breeze.

At the north end of East Hampton stands the old mill-tower which has become famous on canvas since the summer tide of artist life set toward the Hamptons. The picturesque scene of which it is the centre has been somewhat marred since the advent of summer boarders and modern improvements in the sleepy old place. Two brightly painted new houses disfigure the foreground. In old times there was a low, mossy-roofed, tumble-down house, with its front smothered in climbing roses. The mill stands on a little hillock. The road, passing on the left, descends into a group of ancient oaks. In the

middle distance roll away the long brown backs of the uplands and beyond are the blue hills of the North Shore. The shingled walls of the tower have a wonderful charm of color. The edges of the long old cedar shingles have crumbled away with age, the lines are all softened down, and on the silver-gray ground-tone of their weather-beaten surfaces are countless irregular patches of lichen, in gray-greens and brilliant reds and yellows, producing a mellowness of color over the whole tower which is quite indescribable. This efflorescence of lichen is so thick on a mill which stands among the houses of Amagansett as to lend the tower an effect of having had a wash of burnt sienna.

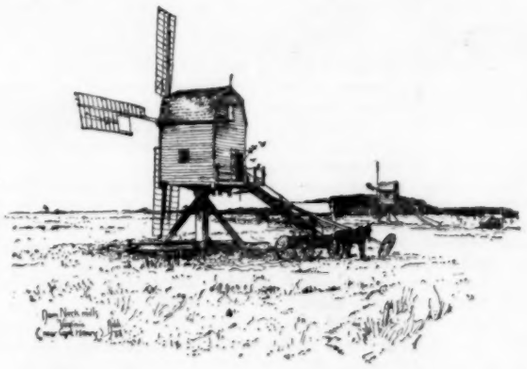
At Bridgehampton I found a tall and stately mill-tower, with a conical roof in swelling lines of very happy effect. This mill is active, and when I saw it there was quite a busy air about the place. The great spars, with their brown canvas full spread, were sweeping round in majestic measure, while from out the tower sounded the deep rythmic rumble of the shafts and wheels. On a platform at the door was a mound of well-filled flour-bags, which a quaint old islander

was loading upon his farm-wagon. The air was pleasantly filled with a floury mist, and a glimpse into the dusky interior revealed a wonderful harmony of great dark-toned timbers vailed in a maze of dusty cobwebs.

The westernmost wind-mill of all the Hamptons stands at the head of Town Pond in Southampton. Down under the hill are grouped some fine old willows, under whose shade is the much-begrimed village smithy. Beyond some cat-boats and skiffs ride at anchor. Down along the sloping green shores of the narrow pond are some very picturesque modern cottages, rich in the russets and yellows, faded greens and gloomy browns of shingle-stains, tones exasperatingly unlovely in the eyes of the natives, who have a strong affection for paint in brilliant hues.

I saw the mill at work, with old ragged sails stretched upon the latticed spars which slowly moved before a light easterly draught. The tower was silvery gray in the sunshine, with here and there a darker blot where the old shingles had been patched. Going in through a door in the stone base, which is about eight feet high from the ground, I climbed from floor to floor until I stood up under the roof where the great beam turned by the revolution of the spars comes in through the side and sets in motion the shafts and wheels of the rude machinery. On the upper side of the plate is a strap-iron rail upon which the roof moves on little iron wheels when pulled round to the wind. The hewn oak beams of the tower are large as well as old and tough, and the construction has an appearance of great solidity. From an upper window, through the cobwebs and dust which have been accumulating for generations undisturbed, I caught a glimpse of the arms of another windmill peeping over the house-tops at the lower end of the pond, and I shortly made my way thither. It turned out to be the original of a sketch of "Windmill Cottage" by Mr. Smedley, printed in *Harper's* not long ago.

This mill was hauled over from its ancient site in the Shinnecock Hills and set up here on the meadow behind the dunes, where it has, for a windmill, a somewhat pent and smothered look. The arms are still in place, and a number of pipes showing about the roof suggest



their use in pumping water up into the tower for domestic purposes. A porch over the door and a two-storied, commonplace cottage on the other side have not added to its beauty.

An old windmill looking out from the hill over Wellfleet Harbor on Cape Cod has also been metamorphosed into a dwelling and a very nice adjunct it makes, no doubt, to the house. Shorn of arms it has lost much of the old grace, but still groups effectively among the houses and trees on the hill-top.

Down along the shores of Pamplico and Currituck Sounds in North Carolina one meets some curious old windmills rather absurdly

perched upon one leg, upon which the whole house turns with the boom. At Dam Neck Mills, on the Virginia Coast below Cape Henry, are a couple of them, picturesquely grouped on a wide sand plain by the sea. But, though interesting, these mills have not the charm of the New England towers.

How well the Block Island mills fit into the characteristic landscape! Green-turfed downs dotted with low stone houses, white hilly roads winding between rough walls of field-boulders, here a lumbering ox-team creaking along the way, there a squad of hissing

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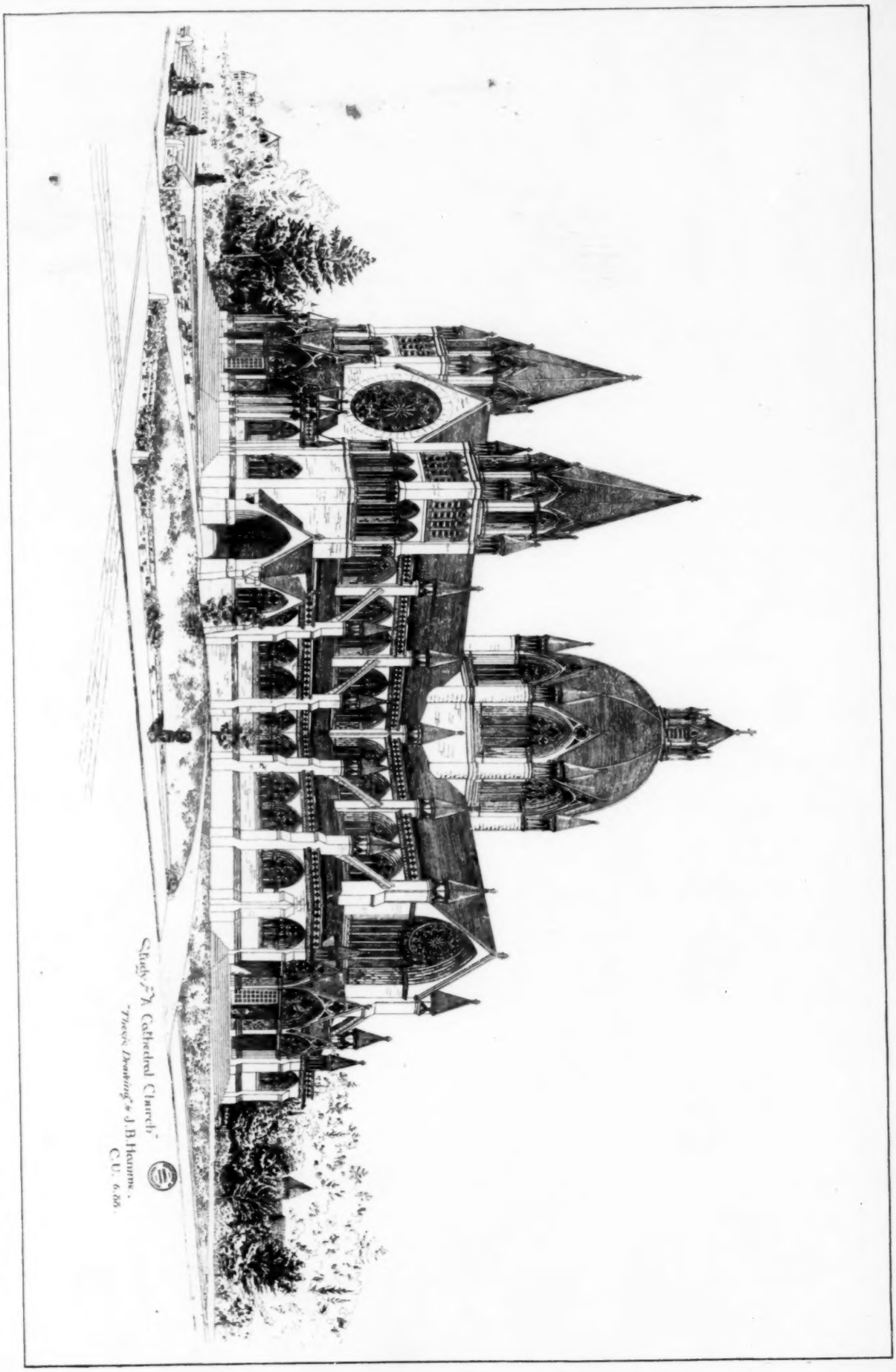

Study for Cathedral Church
"Thesis Drawing" J. B. Heaume
C.U. 6.88.

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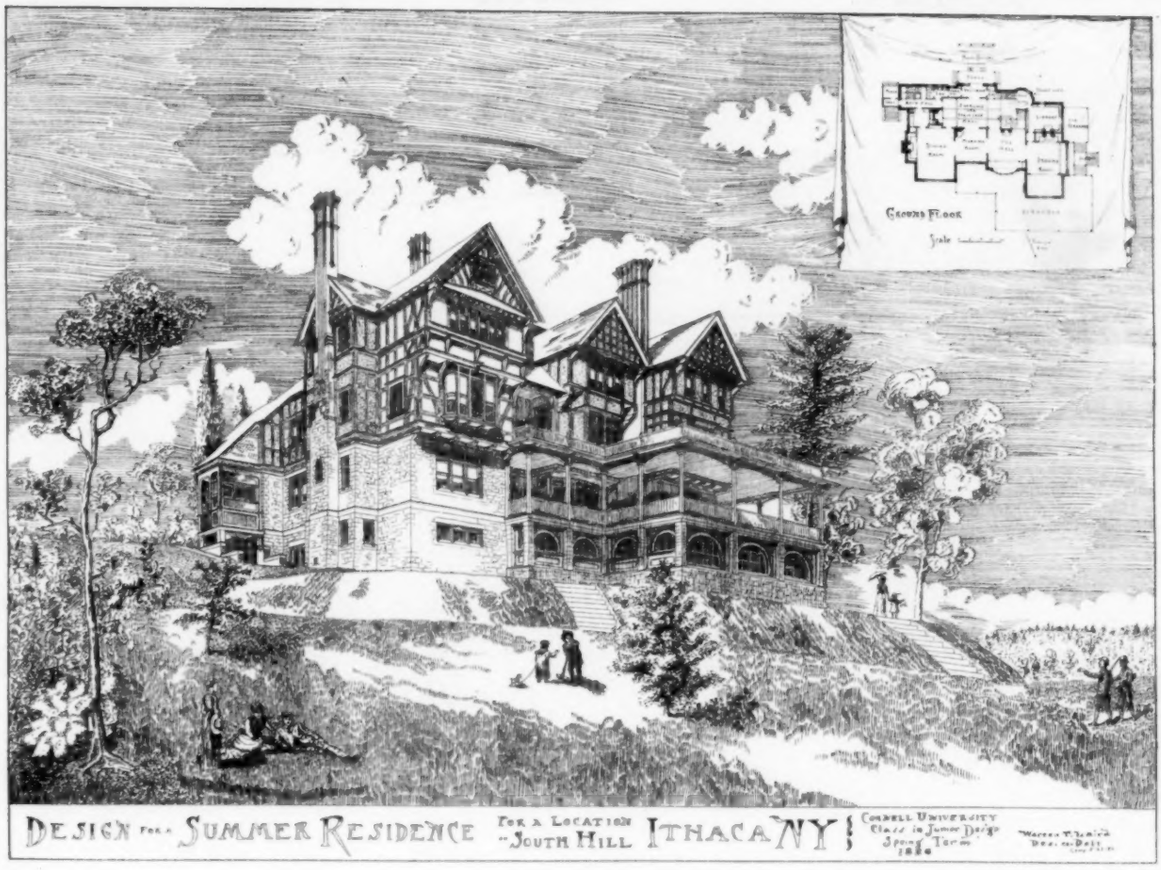
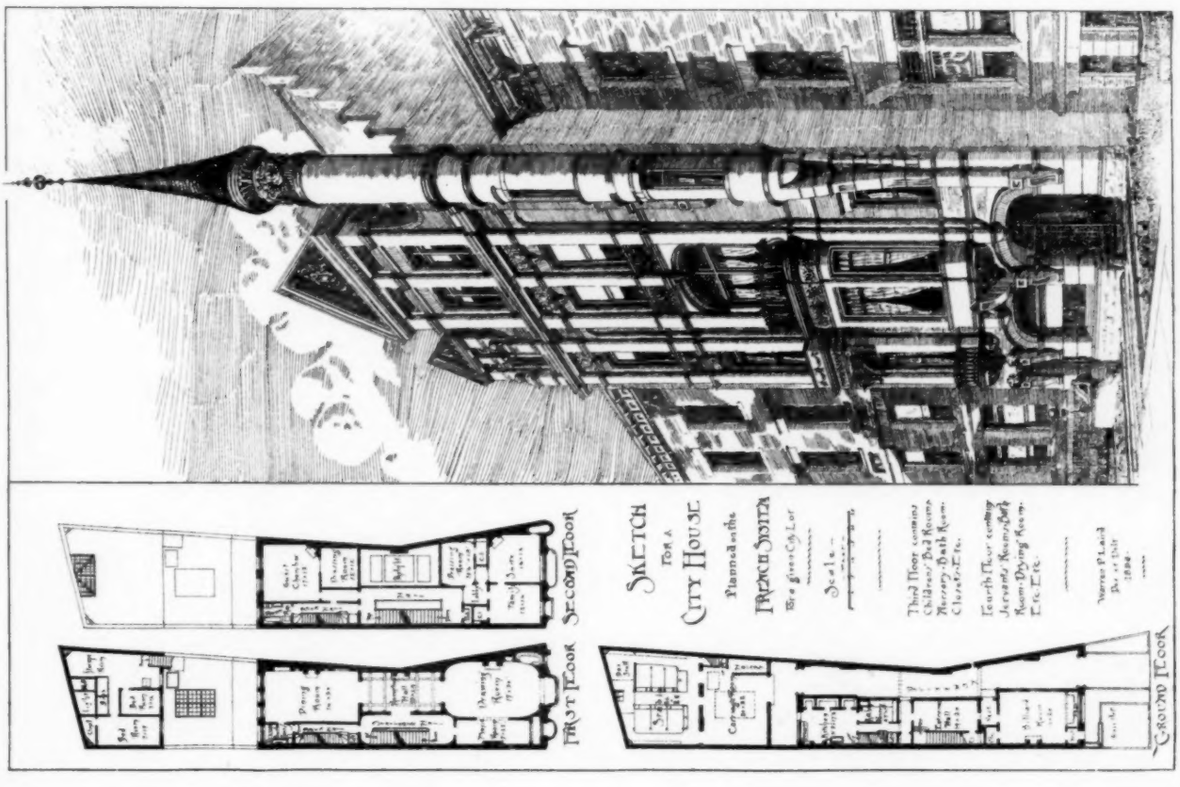

Ground Floor
DESIGN FOR A SUMMER RESIDENCE FOR A LOCATION ON SOUTH HILL ITHACA N.Y.
CORNELL UNIVERSITY
Class in Junior Design
Spring Term
1888



No. 667. American Architect and Building News, Oct. 6, 1888.

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· DESIGN · FOR · A · COUNTRY · HOUSE ·

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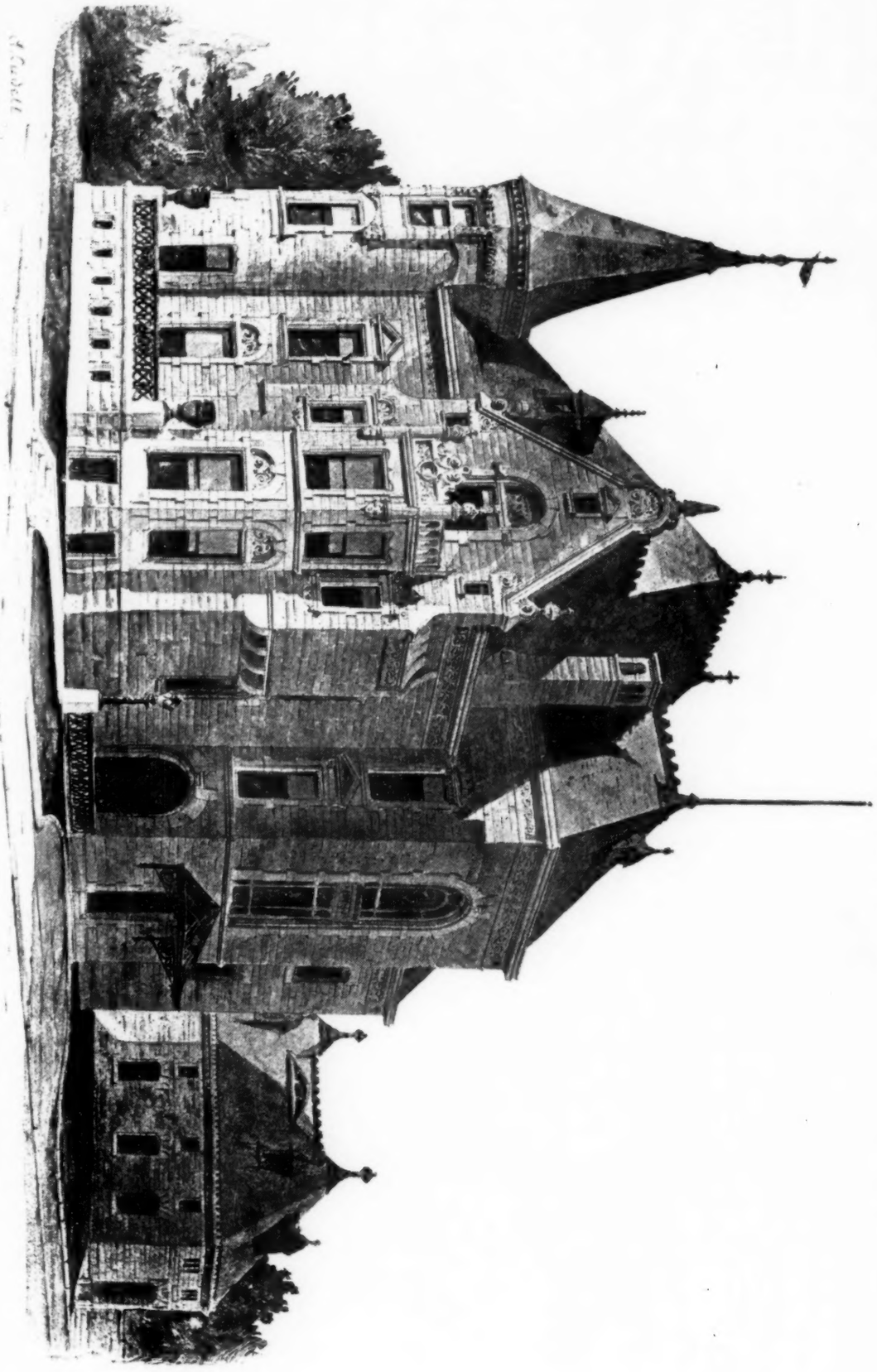

HOUSE OF CONRAD SEIPP, ESQ. CHICAGO, ILL.
A. CUDELL, ARCHT.

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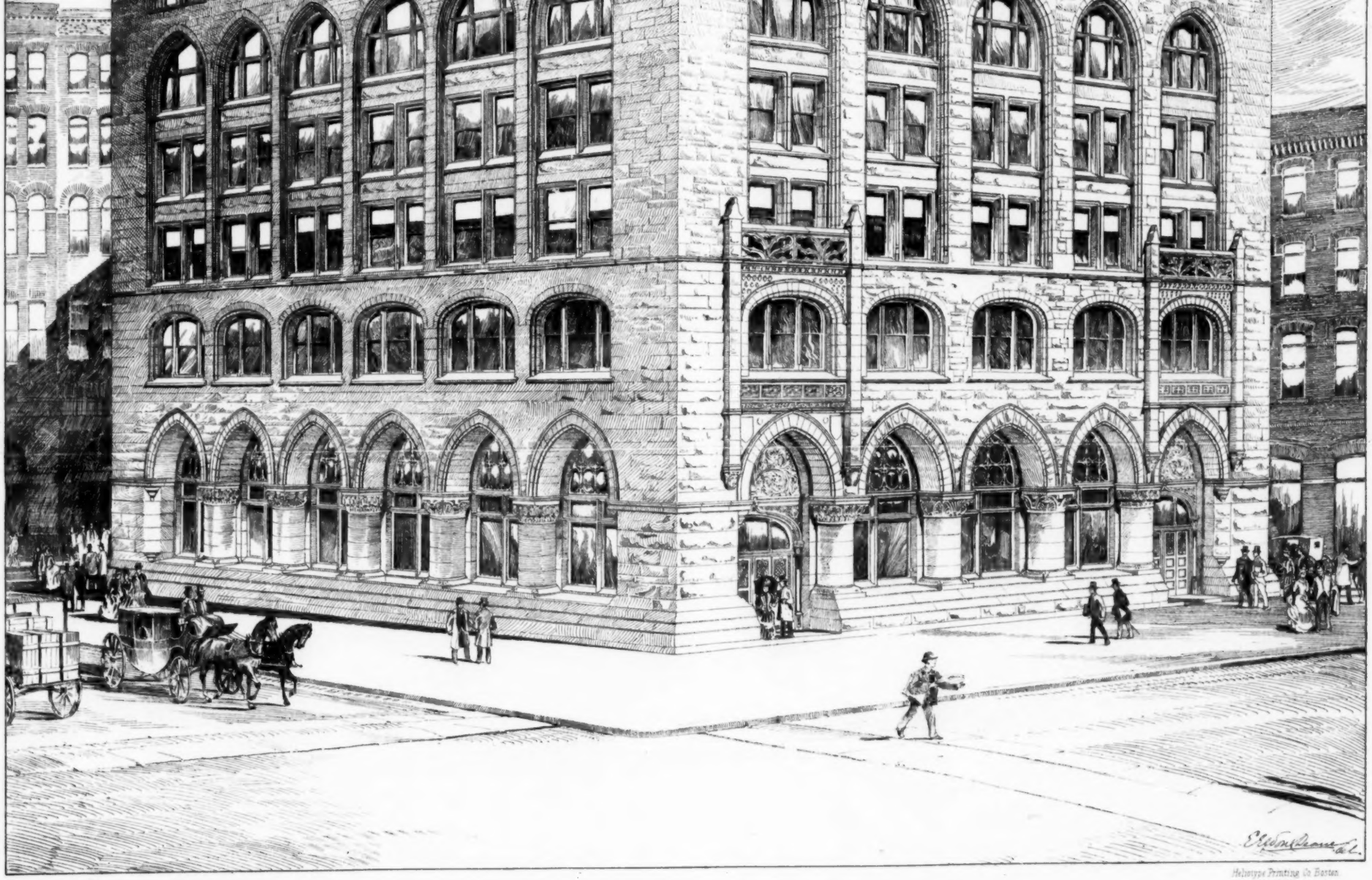


Heliotype Printing Co. Boston.

BUILDING OF THE SOCIETY FOR SAVINGS. CLEVELAND, O.

BURNHAM & ROOT, ARCHTS

geese in solemn march, and far away on the breezy hillside a tapering gray tower, with wings outstretched against the sky and hanging ropes drawn from arm to arm in a sort of cobweb motive. So will I always remember them.

THE ILLUSTRATIONS

[Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

THE MONUMENT TO MARIA THERESA, VIENNA, AUSTRIA.

[Gelatine Print, issued only with the Imperial Edition.]

For description see the *American Architect* for June 23.

DESIGN FOR A CATHEDRAL BY MR. J. B. HAMME. A THESIS DRAWING.

This presents one of the thesis drawings required of graduates from the Architectural Department of Cornell University.

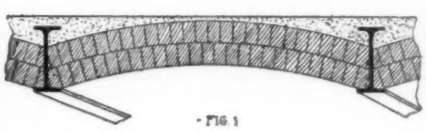
DESIGNS BY STUDENTS AT CORNELL UNIVERSITY.

DESIGN FOR A COUNTRY HOUSE. MR. R. H. ROBERTSON, ARCHITECT, NEW YORK, N. Y.

HOUSE FOR CONRAD SEIPP, ESQ., CHICAGO, ILL. MR. A. CUDELL, ARCHITECT, CHICAGO, ILL.

BUILDING FOR THE SOCIETY FOR SAVINGS, CLEVELAND, O. MESSRS. BURNHAM & ROOT, ARCHITECTS, CHICAGO, ILL.

PRACTICAL APPLICATIONS OF IRON AND CONCRETE TO RESIST TRANSVERSE STRAINS.[1]



- FIG. 1

CONCRETE composed of broken stone, fragments of brick, pottery, gravel and sand, held together by being mixed with lime, cement, asphaltum or other binding substances, has been used in construction to resist compressive stress for many ages.

The Romans used it more extensively than any other material, as the great masses of concrete, once the foundations of large temples, palaces and baths, the domes, arches and vaultings still existing, together with the core or interior portions of nearly all the ancient brick-faced walls found in Rome, testify.

In modern times, however, until the introduction of Portland cement, concrete has been used generally for no other purpose than for footings of walls and foundations underground.

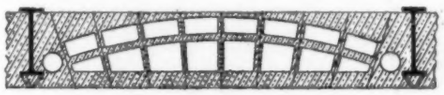
With the introduction of Portland cement, concrete construction has taken a more prominent part, and has advanced regularly with the perfection and general use of that valuable material, until not only foundations but the entire walls of buildings, piers and arches, floors and roofs, have been constructed of it, while moulded trimmings and ornamental blocks are cast of it and set in walls similar to cut-stone.

The cheapness, in most places, of the aggregates composing concrete, together with the fact that mixing and placing may be done with cheap and unskilled labor, under intelligent direction; its enduring and its fire-resisting qualities, together with its great compressive strength, all recommend it for use in permanent constructions. Its low tensile strength and liability to fail without giving warning, under tensile or transverse strain, has hitherto prevented its use for beams, lintels or floors, unless supported by iron beams or other means.

For thirty years or more, so-called fireproof floors have been constructed in England, and some parts of this country, by means of rolled-iron beams, with concrete or brick arches turned from the top of the lower flanges, and levelled over the top, as shown in Figure 1.

This method of construction fulfilled all requirements of strength and safety, except that for which it was especially designed: protection from fire. When subjected to the test of hot fires, its failure was conclusive and the cause apparent. The lower flanges of the iron beams, as the tie-member, and the most vital, being exposed directly to the heat, expanded with it, causing the beams and floor to sag with every increasing degree of heat; at the same time it lost its tensile strength, and failed utterly.

The next step, and the one generally practised at this time, was to encase the lower flanges of such beams with terra-cotta, plaster-of-Paris or other non-conducting materials, as Figure 2.



- FIG. 2 -

Among other methods devised was that shown in Figure 3, where the beams are entirely encased in concrete, extending two or more inches below and above the beams.

While contemplating this method of fireproof construction some twelve years ago, in England, the well-known inventor, Thadeus Hyatt, was led to consider if the iron used in the lower flanges of the beams could not be so united to the concrete as to work in unison

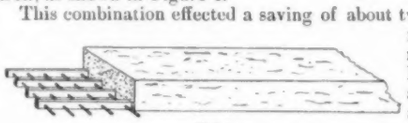
- FIG. 3 -

with it and form a compound beam or girder, the iron to serve only as the tie or tensile member, while the concrete formed the compressive member and connecting web.

Mr. Hyatt made many experimental beams, with the iron introduced in a great variety of ways—as straight ties, with and without anchors and washers; truss-rods in various forms; flat pieces of iron set vertically and laid flat, anchored at intervals along the entire length. These experimental beams were tested and broken by David Kirealdy, of London, and the results published by Mr. Hyatt in a neat form for private distribution, in the year 1877, for the use of which the writer is indebted to P. H. Jackson, a member of this Society, who, in a paper read before it on August 10, 1884, gave many of the results of Mr. Hyatt's experiments in detail, together with some of his own. The final conclusion of Mr. Hyatt, well demonstrated by his tests, was that iron could be perfectly united with concrete, and could be depended upon under all conditions for its full tensile strength.

The method Mr. Hyatt fixed on as the best was to use the tie-iron, as thin vertical blades placed near the bottom of the concrete beam or slab, extending its entire length and bearing on the supports at both ends; these vertical blades to be anchored at intervals of a few inches by round wires threaded through holes punched opposite each other in the vertical blades, thus forming a skeleton or grid-iron, as shown in Figure 4.

This combination effected a saving of about two-thirds of the iron required in the method shown in Figures 1, 2 and 3, as the entire web and top flange was dispensed with, the same amount of concrete serving the double purpose. Although this valuable discovery was given to the world ten years ago, it has not been generally adopted or extensively used either in this country or in England, at least such use has not come to the writer's knowledge, and this not from any failure in the application or defect in the system, but from the general disinclination to adopt new and novel methods of construction, however meritorious they may be.



- FIG. 4 -

For several years past Mr. Jackson, of this city, has experimented with this system, and with variations of his own suggestion, the testing of which has been witnessed by the author with great interest. The results of three of such tests will be given in detail from notes made at the time. The first test was made on January 16, 1884, on a tile of sidewalk-lights 12″ x 24″ and $1\frac{5}{16}$″ thick. This tile consisted of four rows of bull's-eye glass, ten in each row, with five blades of iron, $\frac{1}{4}$ x $\frac{1}{2}$ inches, extending lengthwise, and eleven wires of steel $\frac{5}{32}$ inches in diameter, threaded crosswise. The concrete consisted of one part Portland cement to one part fine screened gravel or coarse sand, and had been made forty-one days. This was tested by being supported on one-inch bearings at each end, leaving one foot ten inches between bearings. The weight was suspended from a steel bar, bedded in plaster, across the centre of the tile.

The deflection was accurately measured at frequent intervals as the load was applied, and recorded in 64ths of an inch.

[1] A paper by G. W. Percy read before the Technical Society of the Pacific Coast and published in the *Transactions* of the Society.

Test of Hyatt Light Slab, No. 1.

Load.—Lbs.	Deflection.—64ths.	Remarks.
885	2	442 pounds to 1-64.
1198	5	138½ pounds to 1-64.
1376	6	
1545	7	
1717	8	
1906	10	73 pounds to 1-64.
2017	12	
2150	13	Fine crack observed.
2210	14	
2300	16	
2350	17	37½ pounds to 1-64.
2405	18	
2468	19	
2531	21	
2600	24	22 pounds to 1-64.
2710	29	Broke by crushing the concrete and glass near the centre bar, none of the iron rods breaking.
2750	—	

Fine cracks were first discovered when the load was about 2,300 pounds and the deflection ¼ inch. These cracks were directly under the cross-wires near the centre. The centre load of 2,750 pounds is equivalent to double the amount distributed, or 3,000 pounds for each square foot of surface between bearings, or a safe load of 500 pounds per foot, with factor-of-safety of 6.

Two tests on these tiles, with quite similar results, satisfied the writer of the strength, and he has not hesitated to use them in practice. The sidewalk-lights around the Fireman's Fund Insurance Company's building are constructed in this manner.

The next illustration of the strength of this combination of iron and concrete was recorded on January 19, 1884, at the Industrial Iron Works in this city, where a slab 4′ 6″ x 4′ 6″ x 3″ thick, made by Mr. Jackson, was tested. This slab had nineteen wrought-iron blades ⅛″ x 1″ placed 2¾″ on centres extending through the slab in one direction and near the bottom, threaded by nine wires ¼″ diameter 6″ apart. Concrete composed of one part Portland cement to two of sand, and sixty-two days old, supported by bearing 3″ at each end, or at ends of blades, and loaded with pig-iron. Deflection noted in 32ds of inch.

Test No. 2.

Load.—Lbs.	Deflection.—32ds.	Remarks.
9,047	3	Or 3016 pounds to 1-32.
12,134	5	1531 pounds to 1-32.
15,167	7	
18,234	9	
21,111	10	Fine cracks first observed.
24,149	12	1442 pounds to 1-32.
26,885	14	
29,554	16	1353½ pounds to 1-32.
32,747	18	
35,206	20	
36,375	—	Broke by parting all the iron blades on the line of wire nearest the centre; the concrete did not crush.

In loading the pig-iron care was taken not to bond it by laying any bars in the direction of the length of the blades, and therefore the pile assumed a somewhat a pyramidal form near the top, thus throwing more weight toward the centre of slab. A fine crack was first observed when the load was about 20,000 pounds and the deflection ⅛″. This breaking load was equal to 2,000 pounds per square foot, or safe load of 333 pounds per square foot, with factor-of-safety of 6.

But one other test of this method will be given, and this was made on the 31st of August, 1885, at the Industrial Iron Works.

Mr. Jackson had prepared a beam 7″ x 14″ in section and 10′ 6″ long. Near the bottom were seven vertical blades of iron extending the entire length; three of these were ¼″ x 1″ and four were ⅛″ x 1″, with ¼″ wires threaded through every 3″. Near the top were bedded two cast-iron rope moulding bars, to assist the compressive strength of the concrete (an unnecessary precaution). The concrete at top and bottom, for about 4″, was one part cement to one of sand; centre portion, one of cement to two of sand. The beam was supported by 9″ bearings at both ends, thus leaving it 9′ in the clear between bearings. It was loaded with pig-iron piled across the beam and bonded only with thin hoop-iron.

Several architects and engineers were present at this test, among others Professor Soulé, of the State University.

The writer had received from Mr. Jackson, a day or two before, all the data in reference to the beam, including its age (about five months). He had estimated its strength based on a tensile strength of 60,000 pounds for hoop-iron, and expressed his confidence to several gentlemen that the beam would require about 27 tons to break, and that it would deflect an inch before breaking.

The result shows nearer than could be expected from calculation on the strength of any materials. Deflections are here noted in 32ds of an inch.

Test No. 3.

Load.—Lbs.	Deflection.—32ds.	Remarks.
20,695	2	10,363 pounds to 1-32.
30,989	3	
33,589	4	1,187 pounds to 1-32.
36,045	8	
38,113	9	
40,056	12	630 pounds to 1-32. Cracks first observed.
42,062	16	
44,077	18	
45,678	21	
46,115	23	475 pounds to 1-32.
47,018	24	
47,996	26	
49,001	28	
50,054	30	369 pounds to 1-32.
52,052	36	
52,892	38	
53,654	—	Broke by separating all the longitudinal blades on the line of one of the cross-wires near the centre.

As will be seen by the above, the breaking load was 26.8 tons and the deflection just before breaking 1 3/16″. Fine cracks were first observed at two or three of the wires near the centre when the load was about 42,000 pounds and the deflection ½″.

This breaking-load of 53,654 pounds was equal to about 6,000 pounds per foot, or 1,000 pounds per foot with factor-of-safety of 6, which would evidently be a perfectly safe permanent load, as the deflection with 9,000 pounds was too slight to observe.

These experiments, together with the results of Mr. Hyatt's tests in London, should satisfy the most sceptical of the practicability of obtaining the full tensile strength of iron as a tie in concrete constructions.

The only objection to be urged against the practice of this method is that, by punching holes for the cross-wires, the effective area of the tie metal is reduced by the amount of the diameter of the holes, and the labor of punching holes and threading wires is quite an item of the cost.

While these experiments were going on Mr. E. L. Ransome, also a member of this Society, and a very successful worker of concrete, was experimenting with a different method of obtaining the same result.

For several years he had used old wire cables as a bond in concrete walls, the irregularity of the wire ropes, caused by the twist of the strands, preventing the possibility of slipping when imbedded in concrete. This probably suggested to his mind the idea of twisting square bars of iron or steel and imbedding them in the bottom of concrete girders or flat slabs, as shown in Fig. 5.

It was evident that this method would be a great improvement over that invented by Mr. Hyatt. The twist in the bar[1] would cause it to be held securely at every point along its length, instead of at intervals of several inches; no metal would be wasted by punching holes, and no extra iron required for anchors. The labor of twisting the cold rods would be but a trifle, and the entire sectional area of the iron could be placed just where it would be most effective.

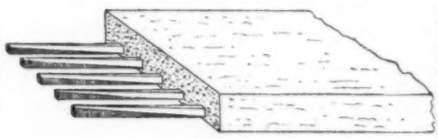


FIG 5.

Mr. Ransome promptly patented his improvement and since 1885 it has been used quite extensively in this city [San Francisco].

The results of two tests of this method, witnessed by the writer, will be given, together with several different applications he has made of it in practice.

The first test was of a slab 12″ wide, 6″ deep and 18′ long, composed of one part Portland cement to five parts gravel and broken granite, with six twisted rods ½″ x ½″ imbedded near the bottom. When about four months old, the slab was tested by being placed on blocks bearing 12″ at each end, leaving 16′ between bearings, loaded uniformly with sand piled on planks laid across the slab. Such a slab without ties could hardly be expected to sustain its own weight. The deflection was noted in ¼ of an inch.

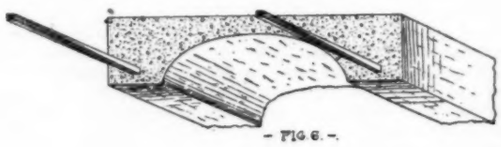


FIG 6.

[1] It has been demonstrated by experiments that the process of twisting the bars to the extent desired strengthens the rods instead of weakening them, as might be expected.

Test No. 4.

Load. — Lbs.	Deflection.	Remarks.
2,830	½	= 1,820 pounds to ½.
3,640	½	
4,450	¾	= 810 pounds to ½.
5,260	1	
6,070	1¼	
6,745	1½	= 630 pounds to ½.
7,420	1¾	
7,960	2	
8,500	2¼	= 540 pounds to ½.
9,040	2½	
9,580	2¾	
9,985	3	= 405 pounds to ½.
10,390	3¼	
10,660	—	Broke by crushing the concrete about two feet from the centre. The slab split for some distance each side of the fracture near the centre of thickness, or at the neutral axis.

The results of this test were given in a meeting of this Society, as before stated, on August 10, 1884, at which time a fragment of the slab was exhibited, showing the position of the rods and the quality of concrete.

The result of the next test, although very interesting, cannot be given in detail, as it extended over several months, and was visited but two or three times by the writer. It consisted of a full-size section of a sidewalk arch and beam, as shown by Fig. 6, 5′ 6″ wide, 15″ deep at beams and 6″ thick at centre of elliptical arch, and 16′ between bearings. At 2″ from the bottom of each side, forming the beam, were 1½″ x 1½″ twisted rods, one in each side.

As it was evident this would require a very heavy weight to break it, preparations were made by laying four thicknesses of 2″ plank across the top of slab, and projecting several feet on both sides. On this platform a strong frame was built, 15′ long (from bearing to bearing) and 11′ wide (just double the width of slab). The sides of this frame-work were not attached or secured to the plank platform so as to assist in any degree in supporting it. The frame-work was filled with clean sand, confined by planks, and the weight estimated by the cubic foot of sand at 100 pounds per cubic foot.

Load. tons.	Deflection. inches.	Remarks.
20	about ¾	
50	" 1½	Cracks on under side about 12 inches apart in centre third.
75	" 4	Cracks extending about 6 inches up.
90	" 6¼	Several cracks ¼ inch open at bottom and extending to within 2 inches of top when last seen by writer.

After standing in this condition for two or three days, more sand was added, when the concrete crushed near the centre.

Before analyzing the remarkable results of this test, let us consider the proper method of estimating the strength of such composite beams.

First, we must consider what is to be the effective depth of such a beam. It is evident the centre of the tie-rods must be taken as the centre of lower member, but the centre of upper member is not so easily located, though it must lie near the top of the concrete.

It is evident that all the concrete above the neutral axis is subject to compressive stress — that stress being greatest at the top surface and diminishing regularly to the centre. It is also evident that as a beam deflects (and concrete, as is well known, yields very little to compression) nearly all the strain must be met by a comparatively thin portion at the top.

It has appeared reasonable to the writer to assume the centre of the top member as one-twelfth of the distance from the top surface to the tie-rods, and to consider that the concrete ($\frac{1}{12}$ of the depth) above and below this line must be sufficient to meet the compressive stress. Thus, if a beam is designed with a total depth of 15″ and the centre of tie-rods placed 3″ above the bottom of concrete, it would leave 12″ as the entire depth from top surface to centre of lower member. One-twelfth of this distance would be 1″ as the centre of top member, thus leaving as effective depth of the beam 11″ and the thickness of top member 2″. Then if a 1″ x 1″ bar, with tensile strength of 25 tons, is used for the lower member and concrete that would crush with one ton to the inch at the top, the beam should have a width of 12½″ to equalize the strength of the iron.

This is the rule the writer has used and believes it errs on the side of safety.

Now, taking the sidewalk arch, as given above, and applying this rule and the usual formula for the strength of iron beams, we have as follows:

Length of beam between bearings	16 feet.
Depth from top to centre of rods	13 inches.
Effective depth — about	12 inches.
Area of iron in tie-rods	4½ inches.
Area of concrete in upper surface, 2 inches thick =	132 sq. inches.

Then formula for breaking-weight at centre of iron bears =

$$\frac{\text{Depth} \times \text{area of iron in flange} \times 80}{\text{Length}} = \text{W in tons.}$$

$\frac{12'' \times 4\frac{1}{2}'' \times 80}{162''} = \frac{360}{16} = 22\frac{1}{2}$ tons breaking-weight at centre, or 45 tons distributed load.

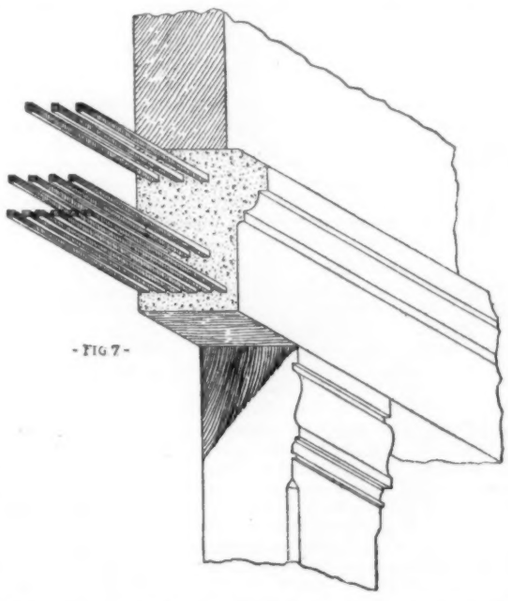
As this formula is based on the breaking strength of iron at 20 tons per square inch of section, and good grades of iron will require at least 25 tons to break by tensile stress, we may add 25 per cent to this result, and consider that from 56 to 60 tons load on the arch and beams should break the rods with tensile strain. Applying the formula for strains with 60 tons load we have this result: $\frac{60 \times 16}{8 \times 1} =$ 120 tons tensile strain on 4½″ iron; also, 120 tons compressive strain on 132 square inches concrete, composed of one of cement to five of aggregate and five months old, which might reasonably be expected to carry one ton per inch.

It will be seen by the tables of weights and deflections of beams, that with about one-third of their breaking-load the deflection was only about one-twelfth of the greatest deflection, and that the load required to produce a given deflection decreased regularly from the first. This may be readily accounted for by the fact that iron yields to extension quite regularly one ten-thousandth of its length to each ton of load per inch until its limit of elasticity is reached, and then it yields more rapidly and in increasing ratio until some grades of iron will stretch one-tenth of their length before final rupture.

As concrete does not yield to compression more than about one one-thousandth part of its length before crushing, it is evident that as deflection increases in beams of this construction the neutral axis must move upward or nearer the top member, thus making less proportional strain on the lower and more on the upper member. This was very apparent in the last test noted, for when last seen by the writer, the cracks due to extension had reached to within two inches of the top of the slab, showing conclusively that the neutral axis must be still higher.

Now, while this may account very satisfactorily for the iron rods not breaking, as they then had a leverage of at least ten inches from the neutral axis, it does not account for the concrete not crushing, as the entire area of concrete then above the neutral axis could not be more than 100″ and its greatest leverage about 1½″, the stress would amount to the enormous load of 4.8 tons per inch for 60 tons load and 7.2 for 90 tons. It is incredible that concrete of such quality could resist such stress for a moment.

It appears to the writer that some of the compressive strain must have been transmitted to the four thicknesses of plank forming the bottom of platform, and some of the load by friction at the sides. If this be so, it renders this experiment worthless so far as the ultimate strength is concerned, but could not affect the early stages of deflection. This arch and beams were designed to carry 400 pounds to a square foot, or total load of 16½ tons with safety. When loaded



- Fig 7 -

to that extent, its deflection was only about ¼″. At this stage it could not have been relieved by the planks or the friction of sand on sides of curbing. The fact that such construction will deflect so much before breaking is a point in its favor, as it gives ample warning when it is overloaded. There have now been laid in this city about 50,000 superficial feet of sidewalk with spans from 10′ to 22′, and no sign of failure or deflection under the heaviest loads that have been placed on them. The writer has applied this system in a variety of ways, some of which will be noted. In the building on the north-east corner of Washington and Stockton Streets, the lintels over store fronts 15′ clear span and carrying three stories of brick walls and wood floors, are of concrete 22″ wide, 2′ 10″ high (with belt course moulded on), and ten 1″ rods placed near the bottom

(Fig. 7). These lintels extend along both fronts of the building, and over the supporting piers are placed three 1″ iron rods near the top, thus giving the effect of a continuous girder, although they are not needed for strength. The lavatory floors in this building are constructed as flat slabs, 6″ thick, 10′ span, with ½″ x ½″ rods every 6″ and placed 1½″ from bottom to centre of rods. Other fireproof floors have been constructed both with flat ceilings, beams and panels, and beams and arches.

In preparing the underground cisterns at the residence of A. Hayward at San Mateo this method was employed with most satisfactory results. The entire cisterns, filtering chambers, flat tops,

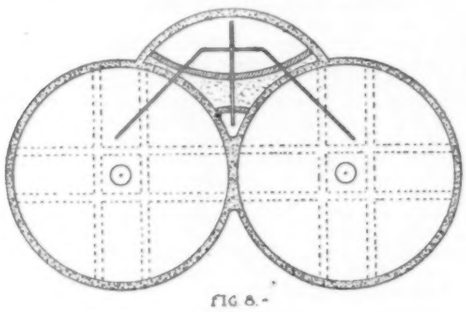


FIG 8.

curbs, and surmounting vases, were all executed in concrete, with two 1¼ x 1¼ rods in each of the deep beams crossing each other on each side of the centre curb, as shown in Figs. 8 and 9. These cisterns are each 27′ in diameter and 15′ deep. The top is covered

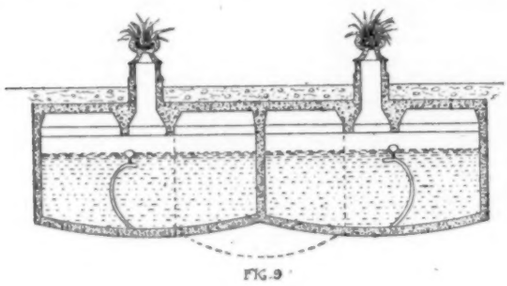
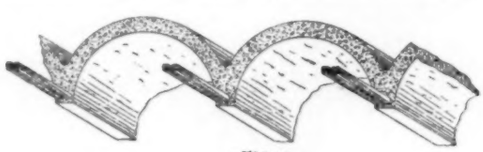


FIG. 9

with 2′ of earth and drays loaded with iron pipe have been driven over them, although the top was designed to be in lawn and not intended for traffic.

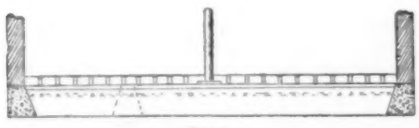
In 1885, Mr. Ransome erected the building for the Arctic Oil Company's works in this city, and made the roof over a fireproof warehouse in the manner shown in Fig. 10. Mr. Ransome describes it in this manner: "This roof is 75′ long by 25′ wide between the walls, which are its sole support. It consists of a number of winged beams, which, being made and jointed side by side, form the roof in a series of semicircular arches, having a diameter of about 3′ and a



- FIG 10 -

thickness of 4″, each beam containing two twisted iron bars 1″ square and 26′ long, placed about 2″ from its bottom. Its calculated strength, verified by experiment, is eight times its constant load. Upon removing all temporary supports and scaffolding on the tenth day, the roof did not show any deflection, although carefully measured to within an eighth of an inch."

In building a brick warehouse in Stockton in 1885 on newly-made ground, the hard-pan being from 12′ to 15′ from the surface, and desiring to save the expense of continuous foundations of such depth, piers of concrete were put in about 15′ apart and with footings on the hard-pan.



- FIG 11 -

At the surface of the ground a base-course of concrete was formed with twisted rods of proper size extending from pier to pier. On this base-course and girder were built the brick walls of the warehouse. In one or two places slight cracks appeared over the piers, which were evidently due to uneven settling.

In one other case, while constructing a brick building of two stories on very soft ground near our city front, the twisted rod and concrete combination was applied in the manner shown in Fig. 11. The footings of the side walls were not allowed to spread out on the adjoining property. Cross walls of concrete were built every 14′, 3′ wide on the bottom and 3′ high, with two 1¼″ twisted rods in each near the top, as it is evident the tensile strain would be in that member. On the centre of these cross walls rest the columns supporting the girder of second floor, while the first floor beams are parallel with the side walls and rest directly on the cross walls, thus distributing the weight of first floor and its load over the entire area. Some settling took place during the erection of this building and several of the cross walls were cracked before the building was finished. No settlement has been observed since and the brick walls have not cracked. The results in this case were as good as could be expected with a great depth of soft mud below. In such situations the entire area of the building should be covered with concrete and the rods placed as high as possible.

Twisted rods of iron or steel imbedded in concrete walls, floors, and ceilings of bank-vaults form a good burglar-resisting substance, as well as being fireproof. On one occasion, while building a concrete bank-vault in an interior town, several tons of worn-out steel plow-shears were placed in the concrete in such positions as would be most likely to discourage burglars in attempting to cut through the wall.

Enough has been said to show the practical character of such combination of iron and concrete in building construction, while many other applications will suggest themselves to the architect and engineer, as in the construction of domes, spires and tall chimneys; in bridges, dams, aqueducts and reservoirs it could often be used to great advantage in strength and economy. To suggest one great national undertaking where the writer believes better results could be obtained at less than half the cost of the present work: the Eddystone Light-houses, both as built by Smeaton and the one recently completed. When one considers the great expense of the intricate dovetailing of the stones together, the trouble in handling and dowelling such masses and the comparatively shallow depth of the anchorage, and then consider that if built with concrete and iron it could be anchored with any number of twisted rods extending to any desired depth into the rock and grouted in with cement, holding at the lower end like the deep and spreading roots of a tree, while at the other end the rods could reach to the very summit, holding with an iron grip the cap-stone to the lowest depth; furthermore, for less than one-third the cost of stone, worked as was the stone in the Eddystone, Bellrock and other light-houses of that class, a concrete could be prepared of Portland cement, dense stone and iron shavings that would be 30 to 50 per cent heavier than granite and better to resist the action of water, while the trouble and expense of placing in permanent or temporary iron curbing would not be so great as handling the cut stone. It has been demonstrated on this coast that good concrete foundations for large engines are much more satisfactory than those built of brick or stone. Now, the writer would suggest that the bolts holding the engines to such beds should be of twisted square iron, thus taking a firm hold at all points through their length and not simply at the lower ends. For setting anchors, bolts or other fastenings in concrete, it is only necessary to twist square or flat bars of iron and imbed where wanted. Iron thus imbedded in Portland-cement concrete, with sufficient thickness of cement around it, is perfectly protected from rust as well as fire, and cannot deteriorate with age. The writer believes the discovery to be of great value to the building world, and that its application will extend as its merits are appreciated and before many years will become general.

SOCIETIES

MAINE ARCHITECTS ADOPT A UNIFORM SCALE OF PRICES FOR THEIR SERVICES.

THE First Annual Dinner of Architects of Maine took place at Preble House, Thursday evening last. The most important business discussed was that of arranging a uniform rate of charges for architectural service. Previously the rate charged has been two and one-half per cent for plans and two and one-half per cent for superintendence, this percentage being reckoned on the total cost of the building. This division of charges was not in accord with the rates adopted by the American Institute of Architects, which are three and one-half per cent for plans and one and one-half per cent for superintendence, making the same total of five per cent on cost for full services.

The rates fixed by the American Institute were unanimously adopted at Thursday evening's meeting. This gives a just division of charges, the old rate of two and one-half per cent charged for drawings and specifications without superintendence being inadequate. The new rates above quoted apply to work costing more than $5,000. For work costing less than $5,000 a list of special rates has been arranged.

It has been erroneously stated that this new schedule of charges

was made after consultation with many of the leading contractors. No such consultation was needed, it being evident to the architects themselves that a readjustment of prices was necessary in order to ensure a fair recompense for architectural service.

The architects present at the dinner were Messrs. Fassett, Stevens, Cobb, Dorticos and Thompson, of Portland, and Mr. Coombs, of Lewiston. Letters were read from Mr. Lewis, of Gardiner, and Mr. Mansur, of Bangor, expressing their readiness to adopt the schedule agreed upon at the meeting. — *Portland Sunday Telegram, Sept.* 23, 1888.

SCHEDULE OF CHARGES ADOPTED BY THE ARCHITECTS OF THE STATE OF MAINE.

For full professional services, exclusive of time lost in travelling and travelling expenses:

For new work costing over $5,000, 5 per cent on cost; 3 1-2 per cent for plans.

For warehouses and factories, 3 1-2 per cent on cost; 2 per cent for plans.

	FULL SERVICES.	FOR PLANS.
For new work costing between $4,000 and $5,000	5 1-2 per cent	4 per cent
For new work costing between $3,000 and $4,000	6 " "	4 1-2 " "
For new work costing between $2,000 and $3,000	6 1-2 " "	5 " "
For new work costing between $1,500 and $2,000	7 " "	5 1-2 " "
For new work costing under $1,500	7 1-2 " "	6 " "

Preliminary studies for work costing over $5,000, 1 per cent on cost.

If preliminary studies only are made, and are used for building, the full payment for general plans will be exacted.

For additions and alterations, an additional charge for measurements.

For monumental and decorative work and designs for furniture, 10 to 20 per cent on cost.

For fixed interior woodwork, 15 per cent on the cost.

Commissions are reckoned upon the total cost of the work, including permanent fixtures necessary to render it fit for occupancy, whether these are selected by proprietor or architect, valued as if executed entirely by new labor and of new materials.

For purchase of stuffs and furniture, 10 per cent on cost.

Travelling expenses to be added to the charge.

Where full services are required, a payment of 3 1-2 per cent on contemplated cost is due on completion of the general drawings and specifications.

Drawings must be paid for whether the work is carried out or not.

Drawings and specifications are instruments of service and the property of the architect.

Builder or contractor must compute all quantities. No bills of quantities will be furnished by us, as this is not within the province of the architect.

Architectural supervision consists of such occasional visits as may be necessary to ensure the conformity of the building to the design indicated by drawings and specifications. We do not agree to exercise the close supervision of a clerk-of-the-works; nor to be responsible for the failure of mechanics to conform to the standard of workmanship called for by drawings and specifications.

ARCHITECTURAL LEAGUE.

AT the first fall meeting of the League, held October 1st, over fifty members sat down to dinner. In the absence of the president, F. Crowninshield presided. The Committee on Current Work announced that the annual architectural excursion had been postponed to the winter season, and that Washington, D. C., had been chosen. Meantime it is arranged to take short trips around New York once a month and give League members an opportunity to see some of the best interiors the city can boast of.

It was voted to incorporate the League at once, in order that any subsequent steps as to a club-house or importation of foreign drawings for the exhibition might be more easily provided for.

The election for the jury for the fourth annual exhibition resulted in the choice of the following: R. M. Hunt, C. F. McKim, R. S. Peabody, T. P. Chandler, Jr., A. D. F. Hamlin.

The Hanging Committee was elected as follows: George A. Glaenzer, E. M. Wheelwright, C. B. Atwood.

The jury for the League gold and silver medal competition, open to draughtsmen under twenty-five, was chosen as follows: C. F. McKim, R. S. Peabody, C. T. Mott, C. A. Rich, E. R. Tilton. In connection with this competition it is understood that the subject for this year's competition is to be the tomb of an illustrious architect.

Definite action in regard to the club-house project was postponed until the November meeting.

* * *

BOSTON ARCHITECTURAL CLUB.

AT a preliminary meeting held in the office of Messrs. Cabot, Everett & Mead, August 27, this committee was appointed to prepare suggestions and make necessary arrangements for the organization of an Architectural Club. The committee would therefore report as follows:

The object of this organization is primarily to create and foster artistic fellowship between those who feel an interest in the subject of architecture, and to aid the members of the profession toward a higher standard of thought and design. The aims are therefore sufficiently comprehensive to embrace not only those who are engaged in the practice or the study of architecture, but also those engaged in other branches of the fine arts, as well as the larger class who would be one with us in instinct and tastes though engaged in other pursuits. We are to organize, in other words, an artistic club, whose chief direction shall be in the lines of architecture, the mother art. But that our growth be large and liberal in its scope, we need the association with the painter and the sculptor, who view art from a purely æsthetic standpoint, no less than with the educated art patron, who often judges of the work of our profession entirely by its practical efficiency. It is the belief of the committee that only by so extending the range of the organization can it ever attain to a permanency, or acquire the influence which we should all desire for it.

It is not the intention that this club shall be in any sense a rival of the Boston Society of Architects. We are working on entirely different lines and expect quite different results, besides being less restricted in our organization. Our interests and our sympathies are one with the society, and it is the hope that our membership will largely include the members of the Society of Architects, for this club is by no means simply an association of draughtsmen, nor are there here any distinctions of persons. We are all united on the common ground of our artistic sympathies, and our architectural interests.

It is believed that it would be a mistake for the club to involve itself in any extended machinery or to indulge in any more red tape than is absolutely necessary for the purposes of the organization. Let the first thought be that of artistic intercourse, the mingling of kindred souls, the rubbing of bright ideas against each other, the cultivation of architectural sociability, and the constitution and by-laws will take care of themselves. Then, as the need therefor makes itself felt, we can have within our midst classes in sketching, life classes, or competitions in design; all of these, however, being purely voluntary, and limited therefore to those who feel a real interest in such things and are willing to give the time to it. In this way the work will perhaps be small in quantity, but it will be earnest and faithful; and when the interest flags, the life of the club will not be necessarily diminished, as has been the case with so many clubs which were restricted to sketches and competitions. For those who have no time for studies, we hope to have pleasant reading-rooms, with all the architectural papers of the world on file, with ultimately a collection of photographs and a good reference-library. There will be also, as a possibility, a comfortable lounging-room where the members can meet in the odor of architecture, smoke friendly pipes, slander each others' latest productions and gossip over the architectural oddities; while the club-rooms would be at the disposal of visitors from abroad, who could make their headquarters with us. Besides this the club would have receptions at stated intervals, with occasional exhibitions, suppers, etc. All of these ideas are entirely in embryo, as yet, but are perfectly natural developments of a club established on such principles as this.

The influence of such an organization, if faithfully carried out, cannot be too highly estimated. What has been possible with the Royal Institute of British Architects and the Architectural League of New York can surely be accomplished in Boston. There is no lack here of either a vacant field or public sentiment. All we have to do is to start the ball rolling in the right track.

At a meeting held September 18, at which nineteen persons were present, this report was adopted and the committee elected to the offices named. It was voted to call the organization the Boston Architectural Club, and to take such steps as might be necessary to interest the profession generally in the enterprise.

The club has the refusal of rooms at Room 10, No. 6 Hamilton Place, where a meeting was held Thursday, October 4, at 7 P. M., to consider further action. All interested are invited.

C. H. BLACKALL, *President.*
RICHARD G. SCHMID, *Treasurer.*
W. T. PARTRIDGE, *Secretary.*

COMMUNICATIONS

MODERN HOUSE DRAINAGE.

TO THE EDITORS OF THE AMERICAN ARCHITECT: —

Dear Sirs, — Probably no change in the art of house-construction during the past ten years has been so great as that in the relative importance attached to the arrangement of apparatus for the convenient holding of water for its several uses and its speedy and safe removal after such uses.

Formerly the planning and construction of the plumbing of a house was left entirely to the plumber. To most house-builders, the including of plumbing with religion and thorough bass, as subjects too sacred to be talked about, would have been readily acquiesced in. The mystery that hedged about the work of the man with tongs and ladle was rarely sought to be penetrated. It is still true to-day that less is known by the owner of the drainage of his house than of any other part of it, but the necessity for *some* knowledge is much better recognized than formerly.

The recent great awakening in regard to general sanitation has borne fruit. This fruit is seen in the greater interest which house-owners take in their local drainage, in the greater importance attached to the subject by architects, in the very considerable literature which has sprung up about it, and in the rise of a new profession — that of men who make a specialty of house and town drainage under the general name of "sanitary engineers."

The foundation of a system of drainage is the soil-pipe, the main artery. The fixtures in the house should be so grouped as to give

the least complication and the shortest runs of waste-pipe, the connections between the fixtures and the soil-pipe. The soil-pipe itself should be run full bore through the top of the roof. As a rule, all piping, whether soil or waste pipe, should be put where it will be seen. Concealed work is apt to be poor work. Also, in case of damage by frost or otherwise, the immediate and accurate location of such injury is important and economical. The soil and waste pipes being erected, the selection of fixtures demands attention. The value of an otherwise good system of drainage may be quite destroyed by the use of improper fixtures.

Water-closets perhaps come first in importance. These should hold a good depth of water to receive deposits and to prevent the extrusion of drain air; their shape should be such as to prevent the fouling of their walls, and their flushing at each discharge should be thorough and copious. Their setting should be open, with no confined space about them.

Wash-bowls should be without concealed overflow or plug and chain. Late improvements in connection with standing overflows make the latter device the only proper one.

Bath-tubs should be of sufficiently heavy copper or other material to make them durable. The standing overflow and waste, to the exclusion of the concealed overflow and plug and chain, is here of even more importance than in the case of wash-bowls, and the size of the outlet should be so large as to deliver the water from the tub into the drainage system rapidly and with all the scouring effect of which such a large body of water is capable.

Sinks should be large enough to give ample room and should have special provision for preventing the clogging of their waste-pipes by congealed grease. The so-called "grease-traps" do this partially, but only by providing another receptacle to become clogged.

Where set laundry-tubs are used they should be of some non-absorbent material.

Each fixture (except the water-closet, whose trap should be in its bowl) should be trapped, as close as possible to its outlet, with a trap of good seal and not subject to siphonage. N.

SCHOOL ARCHITECTURE.

Sept. 7, 1888.

To the Editors of the American Architect:—

Dear Sirs,— Will you kindly inform me where the work on School Architecture by Mr. E. R. Robson, mentioned in your issue Sept. 1st, can be obtained and the price of the same.

Yours respectfully, T-Square.

[Order through any bookseller, or write direct to B. T. Batsford & Son, 52 High Holburn, London, for price. On receipt of money order for the amount with enough to cover postage, they will send it by mail, and the duty will be collected at the Post-Office on delivery. The cost will be from $8 to $12, according to the condition of copy sent.— Eds. American Architect.]

NOTES AND CLIPPINGS

Suit Over a Clock.—The case of Mrs. Amy F. Cole vs. Misses Laura O. and Emily Wheeler (better known as the Sharon bell case) was tried before the superior court, with Judge Torrance presiding, at Litchfield, Ct., last week. In 1885, the Misses Wheeler, wealthy ladies from New York and having a summer residence in Sharon, leased of Henry J. Taylor a small parcel of land in the village of Sharon, directly in front of the Sharon Hotel and within about 120 feet of it. Upon this lot they caused to be erected a handsome stone tower, about 60 feet high. In the top, which was uninclosed, was placed a large bell weighing 2550 pounds, and a clock arranged to strike (with a steel hammer weighing between 60 and 70 pounds) the hours of the day and night. The clock began striking in October, 1885, at a time when the guests of the hotel had returned to their homes in the cities. In the spring and summer of 1886 it was ascertained that the very loud noise made by the striking of the clock was annoying to the guests of the hotel. In the spring of 1887 the Misses Wheeler consented that the striking of the clock should be discontinued during the summer months. In July, 1887, a petition was circulated in Sharon, requesting the Misses Wheeler to begin the striking of the clock again "as soon as may be without injury to any." In the latter part of July, 1887, the Misses Wheeler notified the manager of the hotel that the striking of the clock would be resumed Sept. 1, 1887. On the thirty-first day of August, 1887, a temporary injunction was served upon the Misses Wheeler, restraining them from striking the clock. A large number of depositions, 70 or more, were taken by the plaintiff and defendants in New York and Sharon, and on Tuesday of last week the trial began before Judge Torrance at Litchfield. Between two and three days were occupied in the trial, and, after the arguments for the plaintiff and for the defendants, it is reported that the judge, without intimating what his decision would be, suggested enclosing the west opening of the tower nearest the hotel, and that other steps be taken to lessen the noise. It is understood that the Misses Wheeler will consult their architect as to the best way to lessen the noise, and that, acting upon the suggestion of the court, they will try and remedy the inconvenience.—*Boston Herald.*

Pine Timber at Quebec.—It is reported that not a stick of square white pine remains unsold in the hands of lumbermen at Quebec, Canada, all that is in port and all of this year's cut that is to arrive having passed into the hands of shippers—a condition of things never known at that market before. It is also said that there are only 30,000 feet of waney board pine yet unsold to arrive, and that is this year's cut. Thus it is probable that the smallest stocks on record will be wintered over. This will be an incentive toward reasonable activity in the woods, but it is believed the most of the lumbermen will take care that the market is not overstocked, especially since stumpage is commanding enhanced figures. Yet from Montreal it is reported that big preparations are being made for the winter's operations, for should there be a removal of the United States customs duty on lumber, manufacture would be increased at Ottawa and other important points, and logs would be in demand. Prices for lumber at the mills are reported lately increased. The Canadians appear to be looking for a boom in lumber.—*Northwestern Lumberman.*

TRADE SURVEYS

The most salient feature in American industrial activity is the decentralization of industries throughout all States and Territories. This movement has been accelerated by the anxiety of American and foreign capital to seize the advantages which are presenting themselves on every hand. The low prices of raw material and its abundance, low prices of labor and its disinclination for agitations for higher wages, low rate of money and expansion of railway facilities into so many new quarters and abundance of the supply of fuel, raw and artificial, and other advantages have been stimulating these movements also. The movement has only started. Capital now sees more clearly than before all the opportunities in view. The depression in prices which has taken place this season has been the deciding point. Up to this year capital was apprehensive that the limit of enterprise had been reached for the time being and that the production was abundantly equal to all requirements that might be presented for a year or two. A multitude of things are at hand to prove that there are now five opportunities where there was one three years ago for profitable investment and business capacity and enterprise of all kinds. The most encouraging feature which has presented itself during the past three months is the projection of a large amount of railway building. Some twenty or thirty lines of over one hundred miles have been determined on in that time. One of these enterprises worthy of notice is the construction of a four hundred mile road connecting the Mexican National with Mexican Central, passing through the Coahuila coal-fields and Laguria cotton-belt and the Sierra Mojada mining district. This mining district now produces 60,000 tons of traffic per year, which can be vastly increased by proper railway facilities. Another enterprise deserving of attention in Mexico is the projected construction connecting the Atlantic and Pacific by a new line. It is somewhat longer than the Tehuantepec line, but will cost less. It will profit by the Guatamala coffee trade, amounting to 50,000 tons per annum, and will reduce the time between New York and San Francisco to sixteen or seventeen days. This road is the precursor of other lines to build up a trade with Central America. Preliminary surveys have been taken and very inviting chances are said to exist for investment of capital, but it is in our own country that encouragement is to be found. A four hundred mile road is to be built next season from a point in Indiana on the Baltimore & Ohio road to Lake Huron. It will pass through a section of country now very sparsely supplied with railway facilities. The promoters are making inquiries for materials of all kinds, from ties up. Another road two hundred and twenty-five miles long is projected from Wisconsin to the Mississippi River. It will be completed on the other side at a little later day to Council Bluffs. Another road three hundred and seventy-five miles long will be completed from a point in Minnesota to Omaha.

Two foreign syndicates have subscribed some $17,000,000 to construct railways in Canada to create new outlets for the products of the Dominion. Another at St. Johns aiming at the development of some territory west of the Mississippi poorly provided with railway facilities. The road between Charlestown and Milwaukee is now being pushed to completion. It will develop rich coal territory between where it will cross the Ohio and Columbus. Some twenty or thirty roads are to be built throughout the interior of the country. A road 125 miles long in Florida. Instances of this kind could be multiplied to any length, but they serve to show that a new railroad era is opening despite all the talk about over-construction and decreased earnings. The fact of the matter is, that at no time has there been as much railroad enterprise shown as is now manifested. A great deal of money is to be put into bridge-building and into railroad and ship building, and into the extending of roads into new countries where traffic can be had. The Jersey Central is expending $250,000 upon its purchases. The New York & New England has improved its rolling-stock. The Pennsylvania Company is ordering 1,500 box-cars. The Central, of Georgia, has negotiated a $10,000,000 loan, and has just ordered two new steamers to ply between Savannah and Northern ports. The Louisville & Nashville has grand schemes in view looking to the development of new traffic resources in the South. An immense amount of railroad work is to be brought into the market during the fall and winter. During the past two weeks inquiries have been made for 100,000 tons of steel-rails. A large system has inquired for thirty thousand tons. The Gould system in the West will be in the market just as soon as some of its financial kinks can be untwisted. Several of the leading systems of the Southwest will be in the market for wheat and bagging cars. Competent authorities state that before the close of this year freight-cars will be ordered to the extent of 20,000 to 25,000. The reason for the placing of large orders is that iron and steel are at their lowest, and yellow-pine and oak also at their cheapest points. At least, railway managers feel that they will be running unnecessary risks if they postpone further placing of orders for next year's facilities. The feeling exists that confidence may be strengthened within the next three months, that the upward tendency of prices will be the result. The fact that we have done, so far this year, about ten per cent less business than last is one reason for anticipating that next year we will make that up. It is probable that we will do much more. The industries have been so compactly organized that over-production has been impossible, and, in fact, a good accumulation of stock is hard to find. Prices are held firmly everywhere. The lumber trade is in excellent condition. Prices are steady and demand strong. Profits are fair and speculations absent. Manufacturers express satisfaction with the year's results. Northern iron-makers continue their investments in the South. The Thomas Iron Company have just been building another furnace and rolling-mill that will employ 1,000 hands. The textile manufacturers are running along as though the world were crying for cotton goods. At this time 242,000 spindles and 4,800 looms are being added to the mills now in operation. At the end of the present year the South will have 1,736,000 spindles and 38,800 looms.

S. J. Parkhill & Co., Printers, Boston.

The American Architect and Building News

ADVERTISERS' TRADE SUPPLEMENT.

No. 76. SATURDAY, OCTOBER 6, 1888. VOLUME XXIV. No. 667.

CABOT'S "ANTI-PYRE."

THIS is the first and only protection against fire that is cheap. It is the only liquid fireproofing we know of that is not dissipated by prolonged heat. Wood treated with this, if exposed to direct flames, will slowly char and emit inflammable gas at the point attacked if the flame is very hot, but the fire cannot spread, and entirely ceases as soon as the heat is removed. It is the only fireproofing that can be applied with a whitewash-brush by any boy. It is an excellent protection against colds and draughts, and can easily be applied so as to fill the cracks between boards, thus answering the purpose of plaster. An excellent fireproof substitute for back-plastering, if heavily applied. "Anti-pyre" prevents all danger of fire from sparks, hot coals, explosions from any cause, and spontaneous combustion. It can be used on all woodwork which needs protection from fire, and is not exposed to the direct action of rain. If used on outside work, a coat of linseed oil or of paint should be used over it. It is a complete substitute for tinning, and entirely avoids the two objections to that fireproofing: first, the expense; second, the possibility of the fire getting behind the tin, and doing its damage where it is almost impossible to get at it.

Of course, no fireproofing of this nature renders the combustion of the wood impossible, but it does make it so difficult that there is no danger of the fire spreading, even when there is unusual exposure.

We may mention that we have sold many thousand pounds to the Calumet and Hecla Mining Company, since their last fire, for the protection of the timbers used in the mine.

Among the places where it can be used to a special advantage are the following: —

Interior walls of chemical-works, gas-works, boiler-houses, rubber-works, saw-mills, tanners' and curriers' shops, varnish-factories, oil-distilleries. All places where naphtha and benzine are used. Oil-cloth factories. Around house-furnaces, furnace and steam pipes, chimneys, paint and oil stores, paint-shops, picker-houses, flour-mills, storehouses, laundries, etc.

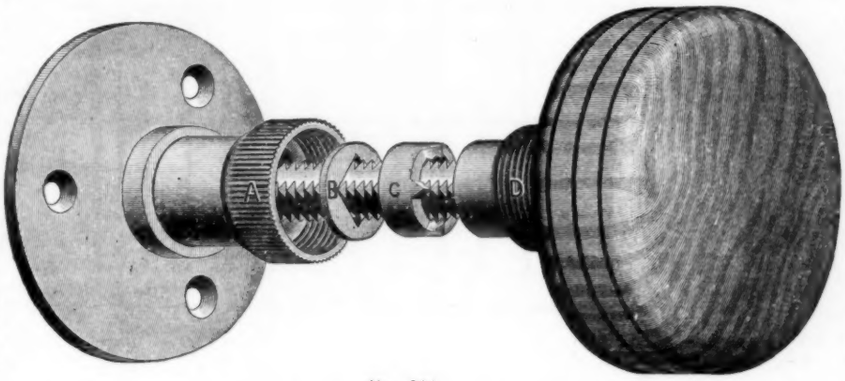
It can be had in almost any color desired.

In estimating for a given surface, it is safe to say that one gallon will cover fifty square feet, two coats heavily applied, on rough wood; if used on smooth wood, one gallon will cover about one hundred and fifty square feet, two coats.

It is put up, ready for use, in one and five and ten gallon pails, fifteen and twenty gallon kegs, twenty-five and thirty gallon half-barrels, and in barrels containing forty to fifty gallons.

For samples on wood and further information, address,

SAMUEL CABOT,
70 KILBY STREET, BOSTON.



No. 301.

DESCRIPTION. — This fastening dispenses with the side screw, which has a tendency to shake loose and drop out. The shank **A** is hollow, and has a shoulder at its inner end. **C** is a nut which is screwed on the spindle to the inner end of the shank, pushing the washer **B** before it. The knob has a square aperture in its shank **D**, slides on the spindle, and the shank **A** is screwed upon **D**, drawing the knob up to its place. These knobs are quickly and easily applied, and give a perfect adjustment to the thickness of the door.

SCREWLESS-FASTENING KNOBS.

THERE has long been a desire on the part of architects and others for a door-knob which would dispense with the ordinary side screw, that is, the screw which holds the knob to the spindle and which unless nicely fitted has a tendency to shake loose and drop out, permitting the knob to come off in the hand, which as all know who have had the experience is a great annoyance. The illustration shows a recently patented method of overcoming this imperfection. In applying these knobs the roses are first screwed to the door, the spindle on which one knob is already fastened is passed through the door, the hollow shank A is put in place, the nut C pushing the washer B before it is turned up against the inner shoulder of the shank A, the knob which has a square aperture to fit on the spindle is next pushed on and the shank A is screwed upon the part D drawing the knob to its place and covering up the washer B and nut C. This forms a neat and secure fastening, it is impossible for the knob to pull off, the spindle is not weakened by drilling, and there are no disfiguring screws through the face of the knob as in other so-called screwless fastenings. Wood knobs with this fastening are furnished by the manufacturer at a slight advance in cost over those with the ordinary fastening.

It will not be out of place to mention here how popular the use of wooden door-knobs for interior doors has become. The undersigned, who was the originator of this class of goods, started their manufacture seven years ago and has built up quite a large business. He has not been without imitators, but by maintaining the quality of his goods and reducing prices as circumstances justified it he has been enabled to keep in front of his competitors.

J. BARDSLEY,
59 ELM STREET,
NEW YORK CITY.

THE Whittier Machine Company are putting into the building on the corner of Kneeland and Washington Streets, owned by the Hill estate, one new passenger and two new freight elevators all to be operated by their hydraulic hoisting machinery upon their Pressure-Tank system.

They are also about to put into the Continental Bank Building, Boston, a passenger-elevator operated by one of their double-screw, high-speed steam hoisting-machines.

WELLS RUSTLESS IRON.

THE Wells Rustless Iron Company, 21 Cliff street, New York, had for some time previous to this year been manufacturing protected ironware under the Bower-Barff patents. A year or more ago, however, they began experimenting with a new process, the invention of Mr. W. T. Wells, the president of the company, and since the first of the year they have been using the Wells process exclusively. Iron protected by magnetic oxide has become

such a popular article in many lines of trade that a description of this new process will be of interest to our readers. The charge of iron or steel articles to the amount of some 12,000 pounds weight is placed in an ordinary muffle or heating-chamber and there gradually heated during a period of some twelve hours. It is important not to heat any part of the charge so as to blister it, and yet every part must be raised to the dull-red heat required by the process. The inventor prefers to use the gas made by the well-known Siemens Producer in heating the charge and to admit air in limited quantities into the chamber along with the gas coming from the producers, just enough to consume the latter and give a small flame in the chamber. During this operation the dampers are opened, permitting the escape of the products of combustion into the chimney. The heating must be gradual so that the charge will be raised in temperature evenly and equally and all blistering avoided. The increase of temperature should be so regulated that the maximum of heat is reached at the end of about twelve hours, though if a smaller charge than the one mentioned is used a shorter period will suffice. The surface of the charge by this gradual heating is apt to become somewhat oxidized both to red and black oxide, but the effect is irregular and patchy where it does appear at all, and is not of any general importance in the result. The next and final step in the process is to turn on a mixture of steam and carbonic oxide gas when the chimney damper is closed. In this atmosphere of steam and carbonic oxide the charge is left for some five hours, more or less. The heat of the charge at the beginning of the operation is a dull-red and air should be excluded as far as possible. The steam need be under little or no pressure, and may or may not be super-heated before introducing into the chamber. This final step of the process is the essential one, in which is produced the desired result of black or magnetic oxide. The furnace employed, is an ordinary muffle or heating-chamber of the usual construction. It does not require any special appliances to make it absolutely air or steam tight, or capable of standing high pressure, as the Wells process does not require elaborate or costly apparatus. The magnetic oxide produced by this process is described as very hard and comparatively elastic. It stands frictional wear well, but is apt to be injured by hammer blows or rough usage. Wherever the coating is removed rust will form, but it will not burrow under and raise the adjacent coating. The works of the Wells Rustless Iron Company are situated at Little Ferry, N. J., but a short distance from Jersey City, where there are furnaces for treating all kinds of iron and steel. The process is especially adapted to wrought-iron pipe for water conveyance, grate frames and fenders, architectural iron-work, ship-work, gas, culinary utensils, cast-iron soil-pipes and plumbers' castings, etc.

THE WELLS RUSTLESS IRON CO.
21 Cliff St., New York.

ELEVATORS.

We take great pleasure in calling the attention of our friends and customers to our sample elevators, a freight and passenger, placed in the immense Park Building of the Centennial Exposition, Cincinnati.

Our passenger elevator is operated on the Hinkle pressure-tank system, the Laidlaw & Dunn Company, of Cincinnati, furnishing the necessary pump and tank.

The freight-elevator is run from the city water-main, and is fitted with our patent variable device, whereby a great saving of water is accomplished.

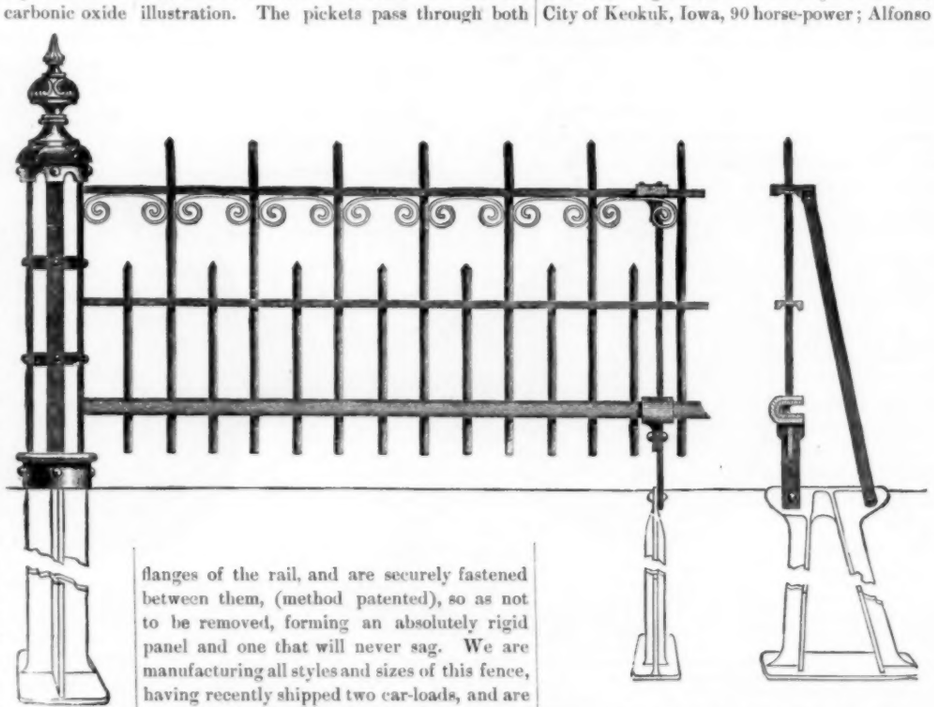
We thus show two styles of our elevators, both of which represent a class of workmanship, which places them foremost among modern hoisting-machines for safety, speed and durability.

We extend a cordial invitation to all to call and personally examine the elevators, and to ask any information they desire of the attendant, who will be pleased to supply it, and to extend any courtesy in his power.

THE JAMES L. HAVEN CO.,
CINCINNATI, O.

WROUGHT IRON FENCE.

The annexed cut illustrates a recent improvement in the construction of wrought-iron fence, invented by us. The special feature of this fence consists of the U-shaped bottom rail, a sectional view of which is shown in the illustration. The pickets pass through both flanges of the rail, and are securely fastened between them, (method patented), so as not to be removed, forming an absolutely rigid panel and one that will never sag. We are manufacturing all styles and sizes of this fence, having recently shipped two car-loads, and are now filling a large order for the City of Natchez, Mississippi, besides various orders for all parts of the country. Any one requiring wrought-iron fence would do well to secure our catalogue and prices, as our fence is better and cheaper than other styles in the market. We are also manufacturers and contractors of building iron work of every description, and make a specialty of wire work, brass work, etc.



J. E. BOLLES & CO.,
DETROIT, MICH.

NOTES.

The sales of Babcock & Wilcox boilers for July and August, 1888, are as follows: Maginnis Cotton Mills, New Orleans, La., third order, 720 horse-power; Pierce, Butler & Pierce M'f'g Co., Syracuse, N. Y., 208 horse-power; J. Arce & Co., City of Mexico, Mexico, second order, 61 horse-power; Morel & Verbeke, Gaud, Belgium, 163 horse-power; Corporation of Glasgow, Glasgow, Scotland, 220 horse-power; Rew & Co., Plymouth, England, 10 horse-power; East River Gas Light Co., Ravenswood, L. I., second order, 51 horse-power; Kaukana Paper Co., Kaukana, Wis., 250 horse-power; Van Nortwick Paper Co., Batavia, Ill., 125 horse-power; Dowson Economic Gas & Power Co., London, England, 114 horse-power; Glenfield Co., Ltd., Kilmarnock, Scotland, second order, 188 horse-power; Bartholomæ & Leicht Brewing Co., Chicago, Ills., second order, 244 horse-power; Hampton Normal & Agricultural Inst., Hampton, Va., 120 horse-power; A. & F. Parkes & Co., Birmingham, England, 140 horse-power; Player Bros., Birmingham, England, 230 horse-power; Societe Française de Materdel Agricola, Vierzon, France, 63 horse-power; Vanderbilt University, Nashville, Tenn., second order, 82 horse-power; Worcester Polytechnic Institute, Worcester, Mass., 51 horse-power; Gordon's Mills Paper Co., Aberdeen, Scotland, 280 horse-power; Impresa Concesionaria de Agnas Subterraneous del Llobregat, Barcelona, Spain, 61 horse-power; Millward, Bradbury & Co., Liverpool, England, sixth order, 61 horse-power; G. W. Gail & Ax., Baltimore, Md., 244 horse-power; London Elec. Supply Corp'n, Ltd., London, England, 3000 horse-power; The City of Keokuk, Iowa, 90 horse-power; Alfonso Flaquer, Barcelona, for new Electric Station, Valencia, 416 horse-power; E. Atkins & Co., Boston, Mass., for Cuba, third order, 156 horse-power; The Shelby Iron Co., Shelby, Ala., 292 horse-power; Ing'o Cieneguita, Abreus, Cuba, 146 horse-power; Western Electric Co., Chicago, Ills., 208 horse-power Western Electric Co., for N. Y. City, second order, 448 horse-power; Leon Pequin, Vendee France, 40 horse-power; City of Sandwich, Illinois, 61 horse-power; Louis Fontaine, La Madeleine lez Lille, France, 673 horse-power; Grand Ave. Railway Co., Kansas City, Mo., second order, 200 horse-power; Gordon & Maxwell Co., Hamilton, Ohio, second order, 146 horse-power; Takata & Co., London, England, second order, 83 horse-power; Irlbacher & Davis, Buffalo, N. Y., 246 horse-power;

W. E. & J. Rigdon, Kent, England, 75 horse-power; The W. B. Oglesby Paper Co., Middletown, Ohio, 146 horse-power; Plenas Escubos Hermanos, Barcelona, Spain, 121 horse-power; Alex. B. Barry, Moscow, Russia, 40 horse-power; Chicago Sugar Refining Co., Chicago, Ill., third order, 272 horse-power; Black & Clawson, Hamilton, Ohio, 95 horse-power; C., B. & Q. R. R., Ottumwa, Iowa, second order, 60 horse-power; Societa Generale Italiana de Elettricita Sistoma Edison, Milan, ninth order, 105 horse-power; A. Flaquer, Barcelona, for new Electric Station, Valencia, second order, 208 horse-power; Anglo-American Brush Elec. Lt. Co., Ltd., London, England, fourth order, 30 horse-power; Consolidated Electric Light Co., N. Y. City, 500 horse-power; Walker Brothers, London, England, eighth order, 20 horse-power; Ing'o Portugalete, Cienfuego's, Cuba, 450 horse-power; N. Y. Life Insurance Building, St. Paul, Minn., 312 horse-power; N. Y. Life Ins. Building, Montreal, Canada, 225 horse-power; St. Paul Railway Co., St. Paul, Minn., 624 horse-power. Making the total sales for two months 13,162 horse-power.

A UNIQUE example of glass work is now on exhibition at the rooms of the Tiffany Glass Company, 333–5 Fourth Ave., New York. It is a window made for a residence in San Francisco, consisting of three long openings, the centre of which is occupied by a full length figure of a maiden clothed in delicate pink; over her head is carelessly thrown a thin vail which hangs in easy folds and is caught at the ends so as to carry the apple blossoms which she has gathered. The coloring is decidedly Whistler-like. The pose of the figure is extremely graceful. The side openings are filled with rather conventionalized floral patterns in faint pink and light yellows. The title given on the window is "Spring." The Tiffany Glass Company consider it a great success in the handling of delicate tones.

During the past week a glass window has been on exhibition during the evenings, at the Fifth Avenue Art Galleries. The subject is "The Talking Well." It is from a painting by Vely in the Corcoran Gallery at Washington. The coloring is rich and the distance and perspective well managed. The second window is also executed by the Tiffany Glass Company.

THE works of the Ball Engine Company, Erie, Pa., manufacturers of High Speed Automatic Cut-Off Engines are being crowded to their utmost capacity with orders for their engines. Among their recent shipments are the following:

Denver, Col., Elec. Illuminating Co., two 80 horse-power engines; Seeger Guernsey Co., St. Augustine, Mex., one 25 horse-power engine; City of Greenville, S. C., one 100 horse power engine; Thomson-Houston International Elec. Co., Australia, one 60 horse-power engine; Atlantic, N. J., Elec. Lt. Co., one 200 horse-power engine; Olean, N. Y., Elec. Lt. Co., one 60 horse-power engine; Paterson, N. J., Elec. Lt. Co., three 100 horse-power engines; Paterson, N. J., Elec. Lt. Co., one 80 horse-power engine; Lynn, Mass., Gas Light Co., one 100 horse-power engine; Electric Improvement Co., Santa Clara, Cal., one 80 horse-power engine; Akron, O., Elec. Street R. R. Co., two 200 horse-power engines; Pensacola, Fla., Elec. Lt. Co., one 100 horse-power engine; Danville, Pa., Elec. Lt. Co., one 80 horse-power engine; Brattleboro, Vt., Gas Light Co., one 80 horse-power engine; Walla Walla, W. T., Elec. Lt. Co., one 35 horse-power engine; Thomson-Houston International Elec. Co., Hioga, Japan, one 25 horse-power engine; Ada, O., Electric Light Co., one 80 horse-power engine; Blaisdell & Pride, Jacksonville, Fla., one 40 horse-power engine; W. W. Cumner, Cadillac, Mich., one 100 horse-power engine; Paul Kuhnke, Clyde, O., one 25 horse-power engine; City Gas Light Co., Norfolk, Va., one 80 horse-power engine.

THE Whittier Machine Company have recently constructed for the West End Street Railway Company, corner of Dunmore and Roxbury Streets, Roxbury, a freight elevator for their stables. Also for the Hotel Gladstone, corner of Broadway and 59th street, New York, an hydraulic elevator operated by their pressure tank system, and for Miss Lowell's building, No. 2 Beacon street, Boston, an hydraulic elevator for passenger service.

THE celebrated "Gorton" House-heating Boilers, manufactured by the Gorton & Lidgerwood Manufacturing Company, New York, are meeting with much favor abroad. The company lately shipped two No. 1 Boilers to Joannes Couvert, Havre, France.

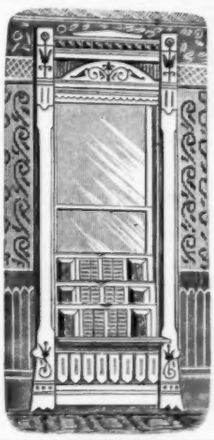
MR. I. P. FRINK,
551 Pearl Street, New York City.

Dear Sir,—The magnificent reflecting chandelier, made from special designs, furnished by you and placed in the West Harlem M. E. Church, corner 129th Street and 7th Ave., New York City, is simply grand. So neat, chaste, and graceful in design that it commands the attention and elicits favorable comments from every one who views it. It lights our main audience room abundantly with as pleasant a light as it seems possible to produce; we rarely use it to its full power. To say that we are delighted with the fixture would hardly express our satisfaction.

Some of the members of our Building-Committee are largely connected with the building interest in this city, and they each endorse the appropriateness of the fixture.

Respectfully, BARTLETT SMITH,
C. FRASER.

SOUTHWARK FOUNDRY AND MACHINE COMPANY,
Engineers, Machinists and Boiler Makers,
WASHINGTON AVE., AND FIFTH ST., - PHILADELPHIA.
SOLE MAKERS OF
PORTER-ALLEN AUTOMATIC ENGINE.
ALSO MANUFACTURERS OF
BLOWING ENGINES, REVERSING ENGINES, STEEL AND HYDRAULIC MACHINERY, BOILERS, TANKS, ETC.
Steam Hammers, Centrifugal Pumps, Rolling-Mill Work.
Inquiries Solicited.



Hartman's Patent Inside Sliding Blind.

A great improvement over all other blinds, slide up and down in the window like sash, move easily, and stay where placed. No hinges, hence no swinging, sagging and tangling with curtains and window drapery. Must be *seen* to be appreciated. Excel *any other sliding blind* in the market for *economy, durability, style, beauty, convenience, etc.* Also the most perfect arrangement for Fly Screens, consisting of an additional section which slides same as the blinds; very much admired by all.

They are also made to slide entirely down to the floor, into pocket, out of sight, without any additional expense. 25 per cent. cheaper than the hinged blind, and *will last double the length of time.*

No more an experiment; tens of thousands now in use. Architects are specifying them. They always give satisfaction.

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Fig 1.

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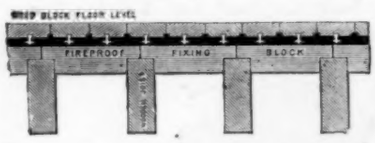
Fig. 2.

Section showing Flat Fireproof Construction where iron joists rest on bottom flange of main girder and in which all ironwork is entirely protected from fire.



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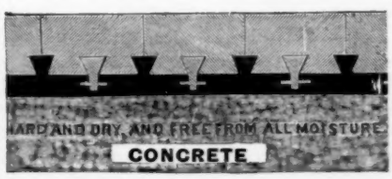

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